Sensitometry • Exposure Numbers • Graininess • Resolving Power • Filters • Development • Fixing • Mixing Solutions • Formulas
Tropical Packing, Handling, Processing • Film Base • Perforations • Shrinkage • Cores and Winding • Packing • Storage
SPECIFICATIONS—Picture Negative Films • Positive Films • Duplicating Films • Sound Recording Films
Supplement on 16-mm. Kodachrome • Color Temperature • Lighting • Exposure • Choice of Colors • Sound • Film Specifications

Properties and Performance of EASTMAN 35 AND 16-MM. FILMS FOR PROFESSIONAL USE

Supplement—COMMERCIAL USE OF 16-MM. KODACHROME FILM

Eastman

MOTION PICTURE FILMS FOR PROFESSIONAL USE

SPECIFICATION SHEETS

35 and 16-mm.

- Release Positive
- Fine Grain Release Positive
- High Contrast Positive
- Fine Grain Panchromatic Duplicating Negative
- High Contrast Duplicating Positive
- Fine Grain Duplicating Positive
- Sound Recording
- Release Positive for Sound Recording
- Fine Grain Release Positive for Sound Recording

35-mm.

- Infrared Negative
- Background Panchromatic Negative
- Background-X Panchromatic Negative
- Plus-X Panchromatic Negative
- Super-XX Panchromatic Negative
- Bi-Pack Orthochromatic Exterior
- Bi-Pack Panchromatic Exterior and Interior
- Bi-Pack Orthochromatic Interior
- Duplitized Positive
- Duplicating Negative
- Duplicating Positive
- Fine Grain Sound Recording

16-mm.

- Panchromatic Negative
- Super-XX Panchromatic Negative

$2

Eastman

MOTION PICTURE FILMS

FOR PROFESSIONAL USE

Motion Picture Film Department

EASTMAN KODAK COMPANY

ROCHESTER, N. Y.

Daniel D. Teoli Jr.
Archival Collection

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Foreword

During recent years many changes have taken place in the photographic materials used in motion picture production. Specialized studio and laboratory procedures have required a number of new emulsion types. With the introduction of these new materials and with the demand for ever higher standards of quality, a distinct need has arisen for detailed information on the characteristics of all the films available. The information compiled in these pages is intended to assist the user in two ways: first, in choosing the film best suited to a particular purpose, and second, in making the best use of the film selected.

The high quality and suitability of Eastman Motion Picture Films are the result of extensive research, long technical experience in manufacture, and close cooperation with the motion picture industry.

It is our hope that this booklet will prove of value not only to those concerned with the production of 35-mm. motion pictures, but also to the growing number of users of 16-mm. films in commercial and educational fields.

EASTMAN KODAK COMPANY

EASTMAN MOTION

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PICTURE FILMS

In the following sections will be found information and recommendations of general application to Eastman Motion Picture Films. Technical data of specific application to individual films are contained in the Specification Sheets which follow the second tab index on page 39. As an aid to the interpretation of these data, it has seemed desirable to include in the first part of this booklet some discussion of the photographic and physical characteristics with which the Specification Sheets are concerned. Information pertaining to the different classes of film, as well as a graphical comparison of the individual films in each class, is contained in pages immediately preceding the appropriate Specification Sheets. Since the professional 16-mm. films correspond in most cases to 35-mm. materials, they are not treated separately except where there is an actual difference in emulsion characteristics.

This booklet is not intended to cover processing procedures or processing solutions except in so far as they are concerned in presenting a complete picture of the characteristics of Eastman Motion Picture Films. For further information on these subjects, the reader is referred to *Motion Picture Laboratory Practice* (Eastman Kodak Company, 1936) and *Photographic Chemicals and Solutions*, by J. I. Crabtree and G. E. Matthews (American Photographic Publishing Company, 1939).

SPECIFICATIONS
Sensitometry
Sensitivity — Exposure
Graininess
Resolving Power
Filter Applications
Filter Factors
Development — Fixing
Mixing — Formulas
Tropical Packing
Tropical Handling
Tropical Processing
Film Base
Perforations — Shrinkage
Cores and Winding
Packing — Storage

Emulsion Characteristics

SENSITOMETRIC DETERMINATIONS

Most image-recording properties of an emulsion can be measured by means of sensitometry, the science of measuring the response of an emulsion to light. The graphical and numerical averages of many sensitometric tests on each film type will be found in the Specification Sheets. Since a large portion of the data is derived from characteristic curves, a brief explanation of these curves is in order.

The Characteristic Curve

Under accurately controlled and standardized conditions, a film is subjected to a series of exposures, each greater by a constant factor than the preceding one. In motion picture practice this is usually accomplished with an Eastman Type IIb Sensitometer, which gives exposures varying in time by the factor $\sqrt{2}$. The film is then developed, still under carefully controlled conditions, and the densities obtained are read on a densitometer. When the density of each step is plotted against the logarithm* of the exposure which produced it, a curve known as the characteristic D-log E or H&D curve is produced.

Associated with the characteristic curve are (see Figure 1):

Toe: For exposures less than that at A, no density greater than fog results on the film. At A, and for greater exposures, densities greater than fog result, and exposure differences are reproduced as density differences. From A to B, the density change for a given log exposure change increases continuously.

Straight Line Portion: From B to C, the density change for a given log exposure change remains constant, that is, the relationship between density and the logarithm of the exposure is linear.

Shoulder or region of overexposure: Above C, the density change for a given log exposure change decreases. Eventually the curve becomes

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*For a discussion of the use of logarithms in sensitometry, see page 71.

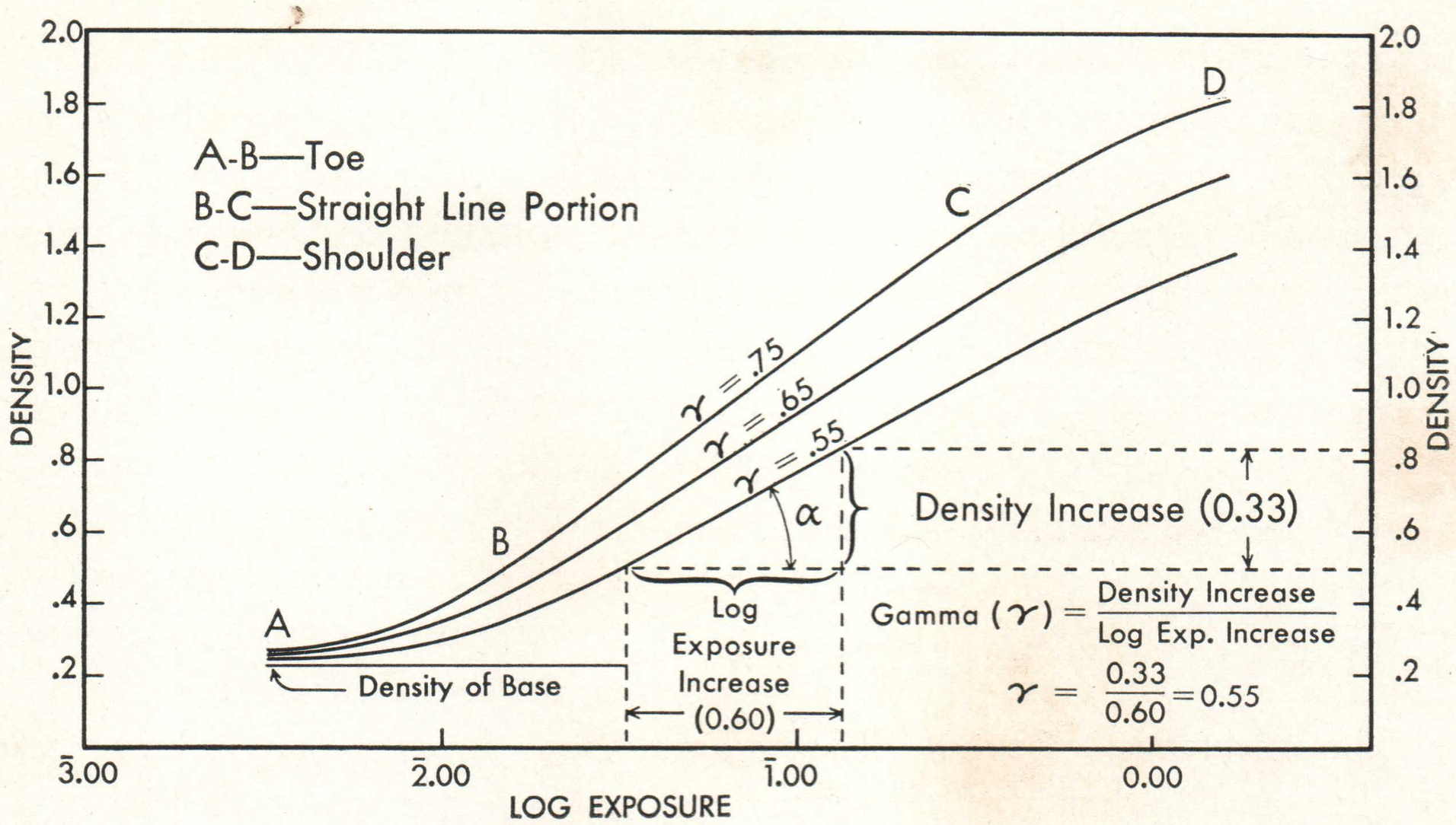


Figure 1. Typical characteristic curves

horizontal and no longer records exposure differences by density differences. Thus scenes recorded on the shoulder of the negative show a falling off in highlight contrast. In practical work, the shoulder region is rarely used.

Gamma is related to the contrast of the film and its processing, and serves as a measure of development contrast. It is defined by the slope of the straight line portion of the characteristic curve, or the tangent of the angle the straight line portion forms with the horizontal. Since the tangent of this angle (α in Figure 1) is equal to the density increase divided by the log exposure increase which produced it, the numerical value of gamma can easily be calculated. If characteristic curves are determined for a series of development times, and the gamma of each curve is plotted against the time of development, a curve showing the rate of growth of gamma with development is obtained. This time-gamma curve can be used to find the required developing time for any desired gamma value.

Fog is the slight density produced on the film during development even in areas which have had no exposure. The net fog value for a given time of development is obtained by subtracting the total density of the film base and fixed-out emulsion from the density of the unexposed but developed and fixed film. When such values are determined for a series of development times, a time-fog curve showing the rate of growth of fog with development can be plotted. With modern films, the tendency toward fog is slight, and objectionable fog levels are not encountered with proper handling.

Interpretation of Sensitometric Results

The various sensitometric curves given in the Specification Sheets are based on averages for normal seasoned product. Although they do not necessarily correspond precisely to those obtained in any particular commercial laboratory, they furnish a reliable guide to the comparative characteristics of Eastman Motion Picture Films because the conditions of exposure and development were standardized throughout.

It should be noted that the characteristic and time-gamma curves represent only the type of results which will be obtained from control samples exposed on the Eastman Type IIb Sensitometer; sensitometric exposures which correspond to practical exposure conditions in the camera, printer, or recorder may produce different curve shapes.

The measured characteristics of the film depend on the spectral quality and intensity of the exposing light, on the exposure time, on the chemical composition of the processing solutions, and on the physical conditions under which the film is stored, exposed, and processed. Since all of these factors may have profound effects on the results, it is necessary to test the film under the actual conditions of use. Only in this way can the user gain a knowledge of the properties of the emulsion in the particular application for which the film is being used.

SENSITIVITY AND EXPOSURE

The characteristic curve represents completely the response of the film as a density-log exposure relationship. From this curve are derived both a measure of the sensitivity of the film and an index to the exposure required in the use of the film.

The difference between the *speed* of a film and its *exposure index* should be clearly understood. Speed is an inherent characteristic of the film, associated uniquely with emulsion sensitivity and its relationship to the development process. Speed is expressed in absolute terms and is based on the *minimum exposure* which will give a final result of high quality. The exposure index is a practical guide to the most suitable exposure required to produce a desired photographic effect, and takes into account not only the speed of the film, but such additional factors as the latitude of the film, the characteristics of the camera, printer, or sound recorder in which the film is to be exposed, and the purpose and technique of use. In order to insure good results under a variety of conditions, the exposure index provides an adequate margin of safety whenever the latitude of the film or the requirements of the reproduction process permit.

Kodak Film Speeds

The Kodak Film Speeds given in the Specification Sheets for picture negative and bi-pack materials provide a measure of the inherent sensitivities of the emulsions in these groups. Each value is based on the minimum camera exposure which will produce a negative capable of giving an excellent print.

Sensitometrically, the speed value is determined by drawing the characteristic curve of the film for the exposure and processing conditions to be used, and laying out on the horizontal axis an exposure range of 30 to 1 (or a log exposure interval of 1.5)—a range which has been found to be a normal illumination scale for the light image formed by the camera lens on the film. This interval (AB in Figure 2) is then moved along the horizontal axis until the gradient, or slope, of the curve at the low end of the range reaches a value 0.3 of the average slope over the entire range. When the slope (or tangent of angle *a*) is 0.3 of the average slope (or tangent of angle *b*), point C represents the exposure value from which the speed value is derived. The Kodak Film Speed is 1/E, where E is the exposure value (expressed in meter-candle-seconds) at point C.

Kodak Film Speeds have the practical use that if the minimum exposure is known for one film, that for another film can be derived from the inverse ratio of the speed values. Good photographic practice, however, requires that the index to exposure should be based on an exposure somewhat greater than the minimum whenever possible. Exposure numbers have been derived to meet this requirement.

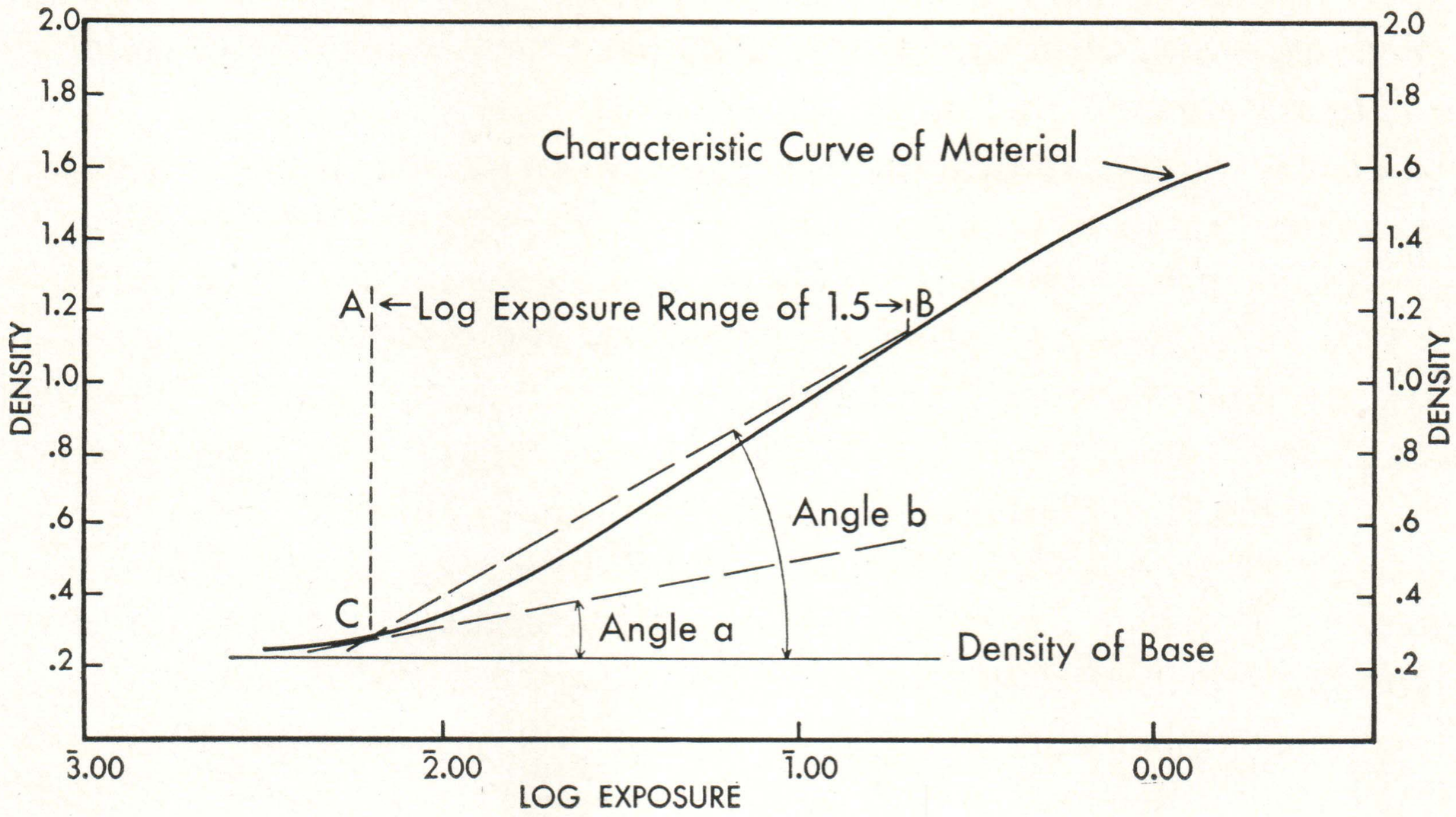


Figure 2. Determination of Kodak Film Speed

Exposure Numbers

The exposure numbers given in the Specification Sheets for picture negative and bi-pack materials are expressed in terms of recommended settings for the Weston and General Electric exposure meters. These figures are exposure numbers rather than speed values because they take into account not only the inherent film sensitivities, but also the characteristics and calibration of the meters, the latitude of the emulsions, and a safety factor. The recommended Weston setting for a motion picture negative material is obtained by multiplying the Kodak Film Speed by 0.25, while the recommended General Electric setting is obtained by multiplying the Kodak Film Speed by 0.40.

The exposure numbers for the other types of films (classified for this purpose as release positive, duplicating negative, duplicating positive, and sound recording) are not derived from Kodak Film Speeds and are expressed on an arbitrary scale. In each of these four groups, a suitable criterion on which to base the exposure numbers has been established. The criterion is associated with that aspect of the characteristic curve which is of maximum significance in the reproduction process. This may be a certain critical density or a fractional gradient, depending on the process and the nature of the desired photographic effect. Thus, for release positive, the exposure value E used in calculating the exposure number is taken at a density of 1.0. For both duplicating negative and duplicating positive, E is taken at a gradient which is 0.8 of the gamma value. For sound recording, E is taken at the density of the sound track (0.55 for variable density tracks). The choice of a criterion based on the process concerned has the effect of making each exposure number in any one group an index to the relative exposure required under practical conditions.

In order that exposure numbers in one group may bear the proper relationship to numbers in the other three groups, each group of values has been adjusted by a factor indicated by practical experience. Thus, the exposure numbers are found by dividing the exposure values, determined as above, into the proper number, which is 10,000 for release positive, 3,000 for duplicating negative, 750 for duplicating positive, and 10,000 for sound recording.

With this adjustment by groups, the exposure numbers have the significance that they are inversely proportional to the exposures required when each film is used for its intended purpose. This is useful for determining what changes in printer illumination and speed will be required for the different types of work. For example, the Duplicating Positive Exposure Number for Eastman Fine Grain Duplicating

Positive, Type *1365*, is 100, while the Duplicating Negative Exposure Number for Eastman Fine Grain Panchromatic Duplicating Negative, Type *1203*, is 600. Thus the printer used for making duplicate positives on *1365* will need to give six times the exposure required for printing duplicate negatives on *1203*.

It will be noted that the films in the sound recording group have been assigned several different exposure numbers. These numbers correspond to several different recording and processing techniques which are in common use, and which are identified by the specification of light source, filter, developer, control gamma for the Eastman Type IIb Sensitometer, and sound track density.

In other groups only one exposure number has been assigned to each film. It is not to be inferred that conditions of use other than those specified do not exist or do not affect the exposure numbers. Wide variations in practice do exist, but a single number has been selected to serve as an index to the recommended exposure under normal or average conditions.

COLOR SENSITIVITY

The color sensitivity of photographic materials is usually expressed by means of wedge spectrograms such as those appearing in the Specification Sheets. These spectrograms are prepared by exposing a sample of film to a light spectrum through a neutral density wedge which is almost opaque at the top and decreases in density until it is transparent at the bottom. The height of the photographic image at any point is therefore proportional to the log sensitivity of the emulsion to that particular wave length, expressed on the scale of the spectrograph in tens of millimicrons. Because of the absorption of much of the ultraviolet by the lens system of the instrument, the indicated ultraviolet sensitivities of all films, as shown by the wedge spectrograms, are lower than the true values. The spectrograms show relative color sensitivity only; since exposure adjustments are made in many cases, they give no indication of film speed.

GRAININESS

On the motion picture screen, graininess appears in the form of a boiling effect noticeable in large areas of uniform tone.

The inherent graininess differs with the various emulsion types; in general, when all other factors are held constant, the faster a film is, the greater its tendency towards graininess. However, recent advances in emulsion manufacture have made possible increased speed without

increased graininess. Eastman Plus-X, Type *1231*, for example, is twice as fast as Eastman Super-X, its predecessor as standard production negative film, yet its graininess is definitely lower. Eastman Super-XX, Type *1232*, has extreme speed, three times that of Super-X, yet its graininess is barely perceptibly greater. Both Plus-X and Super-XX are remarkably fine-grained in view of their high speeds.

The graininess of a picture negative emulsion can be decreased by the use of an effective fine-grain developer, but in motion picture production the use of special developers is seldom practical. If graininess is a problem, the best solution is to choose a film of lower graininess, developing in a developer such as Kodak D-76, which produces the maximum speed of the emulsion without accentuating the graininess.

In addition to the inherent characteristics of the emulsion and the properties of the developing solution, there are a number of other factors which affect graininess. Among the more important of these are:

1. The degree of development of the negative. Graininess increases rapidly with development and therefore with any factor which increases the degree of development.
2. Density. Graininess increases with the density of the negative; hence it is important to avoid overexposure.
3. Processing conditions. When the temperature of the processing solutions is above normal, graininess tends to increase. If the temperatures of some of the solutions are high and the temperatures of other solutions low, there may be a considerable increase in apparent graininess due to incipient reticulation of the gelatin. It is important to keep all solutions at approximately the same temperature.

Graininess in the final print is strongly influenced by the graininess of the negative, but is also affected by several other factors. The most important of these are:

1. The over-all reproduction contrast. Excessive contrast in the print tends to make the graininess of the negative more apparent.
2. Type of image. Graininess is more apparent in images which have large areas of uniform density, particularly if these occur in the lighter middle tones.
3. The graininess of intermediate materials. The graininess of prints from duplicate negatives, for example, is markedly improved by the use of fine-grain duplicating materials.

In release prints made either directly from original negatives or from duplicate negatives, the best results as regards freedom from graininess are obtained when the negatives are developed to a rela-

tively low gamma and the positives to a much higher gamma. This is due to the fact that with negative emulsions the graininess increases rapidly with an increase in gamma, while with positive emulsions the graininess soon approaches a maximum and remains nearly constant over the useful range of contrast, increasing only slowly as the development gamma is raised.

Satisfactory graininess comparisons can be made only by careful examination of screen tests made under controlled conditions.

RESOLVING POWER

Resolving power is a measure of the ability of an emulsion to record fine detail distinguishably. It is one of the most important factors affecting screen definition and sound reproduction.

Resolving power values in the Specification Sheets are given in terms of the number of lines per millimeter that can be distinguished as separated in a photographic image. In measuring resolving power, a test chart consisting of parallel lines separated by spaces of the same width as the lines is photographed at a great reduction in size. After the film has been developed under conditions closely approximating those used in practice, the image is examined under a microscope, and the number of lines per millimeter just resolved is determined. Lines closer together (more lines per millimeter) than indicated by this number will appear on the film as an indistinct gray mass, rather than as individual lines.

The resolving power of a film depends on the contrast of the test chart, the degree of development of the film, and especially on the exposure. The values given in the Specification Sheets for different films are the optimum values for recommended processing and for a subject contrast ratio of 30 to 1. Resolution falls off at high and low exposure values, reaching a maximum at some intermediate exposure, at which the resolving power figure is selected.

Sharpness is another factor which helps determine the best definition which can be obtained in a negative. It is a measure of the ability of the material to reproduce geometrically sharp edges. All emulsions reproduce such edges as graded transitions, but there is considerable variation in the results. Although sharpness is not so well adapted to numerical presentation as resolving power, this characteristic is carefully considered in film manufacture.

Filters

FILTER APPLICATIONS

SINCE filters are usually not necessary or even desirable for interior work, they are employed chiefly when panchromatic negative films are exposed under daylight illumination. The use of filters in exterior work is for the purpose of securing well-defined clouds, lowering the brightness of blue sky or water, penetrating haze in scenes showing distant landscapes, increasing tonal contrast between colored objects which would otherwise photograph with low contrast, and for the production of special effects (such as night effects by sunlight illumination).

While more than 100 Wratten filters of widely varying characteristics are available, for general purposes the requirements of motion picture work are met by a rather small group. The paragraphs below list the more commonly used filters and their applications. The absorption characteristics of a selected number of these filters are illustrated by spectrophotometric curves. In the curves, absorption is plotted as density against wave length; thus, the height of the absorption curve (black portion) at any wave length represents the logarithm of the absorption. Similar curves for all the Wratten filters, as well as other

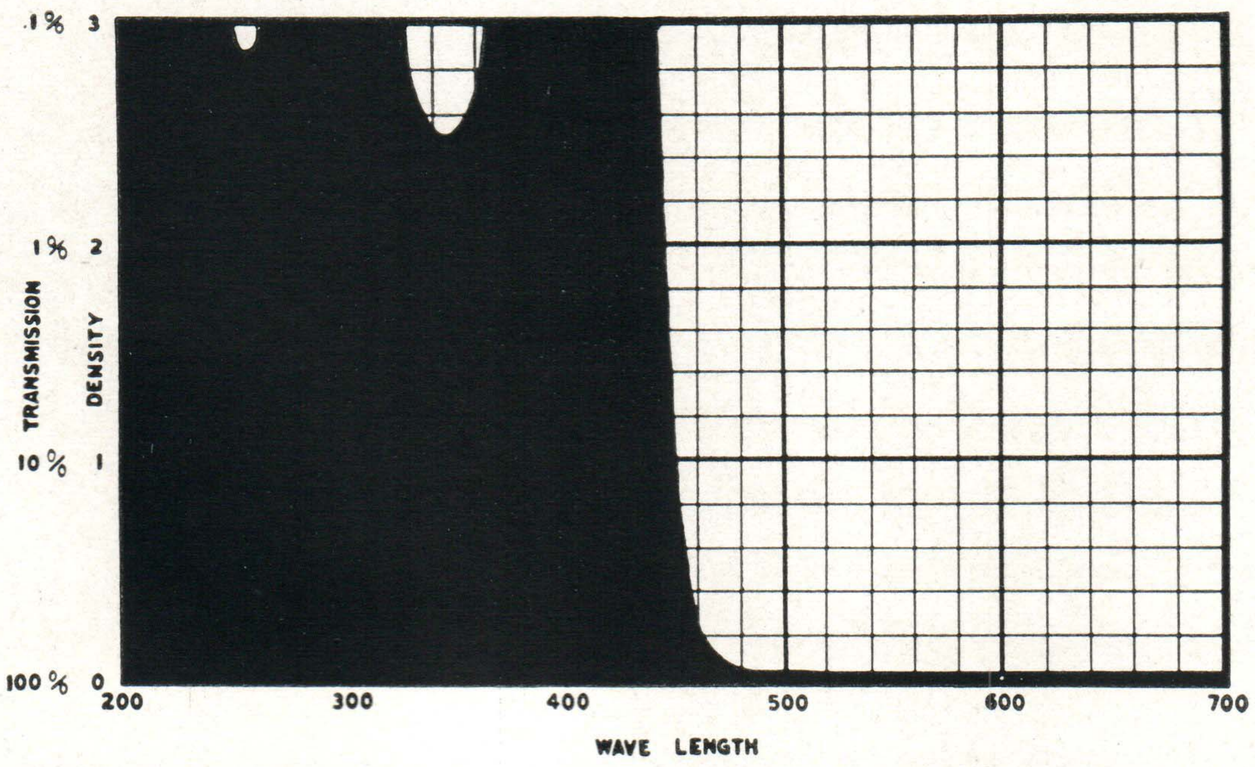


Figure 3. Absorption curve of the Wratten No. 3 (Aero 1) Filter

significant data on their characteristics, will be found in *Wratten Light Filters*, another Eastman publication.

Wratten No. 3 (Aero 1): A light yellow filter which transmits most of the visible spectrum, absorbing the shorter wave lengths up to 440 millimicrons (Figure 3). The transmission in the ultraviolet can be ignored. The Aero 1 is used when only a small amount of sky correction is required; it gives slightly increased contrast in the more distant portions of a landscape and a slight darkening of the sky.

Wratten No. 5 (Aero 2): A somewhat deeper yellow filter than the Aero 1. It transmits (Figure 4) only beyond 480 millimicrons. Because of its absorption in the blue-violet, it reduces the brightness of the sky, causing it to appear darker in the print and giving some contrast between clouds and sky. Also, the contrast of distant portions of a

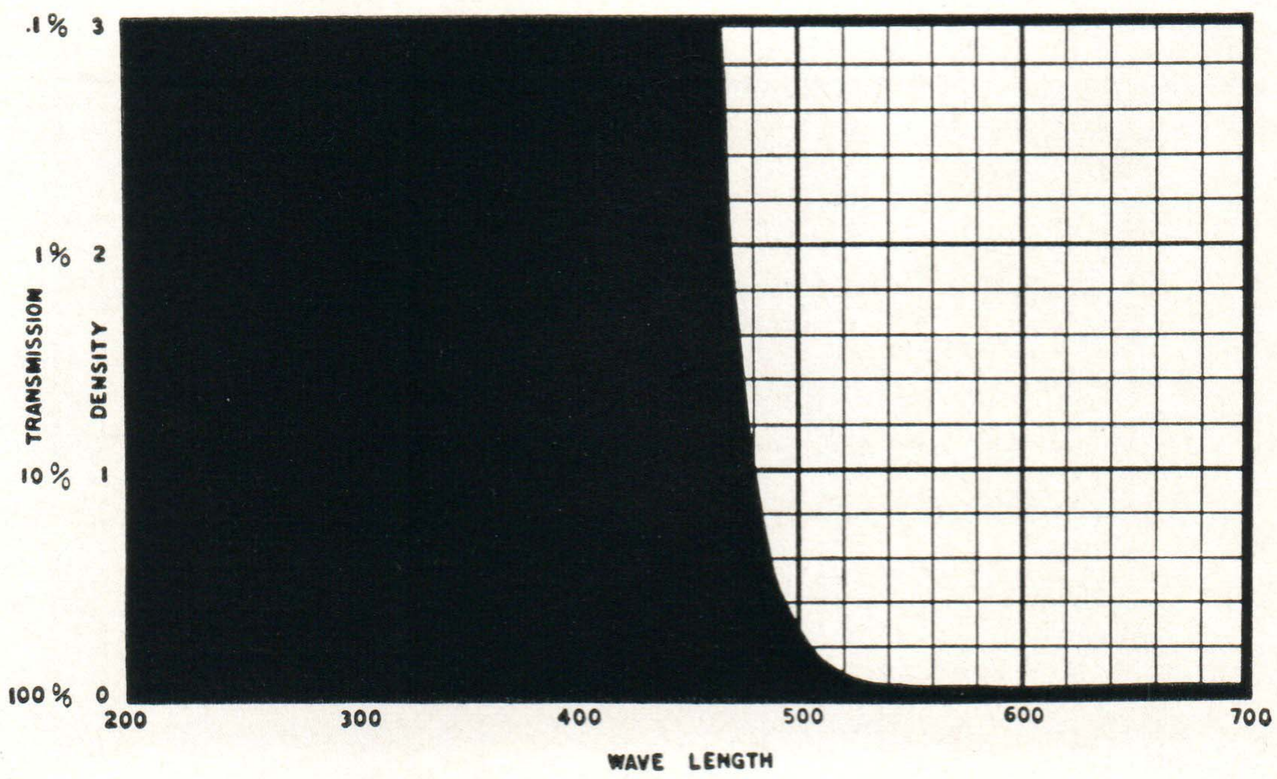


Figure 4. Absorption curve of the Wratten No. 5 (Aero 2) Filter

landscape is slightly increased. This filter is adequate for general exterior photography and does not alter the quality of normal panchromatic make-up. In most cases its use results in more pleasing picture quality.

Of the filters discussed here, the Aero 2, when used with Eastman panchromatic picture negative materials, gives the closest approximation of correct color rendering as seen by the eye.

Wratten Nos. 3N5 and 5N5: These two filters are the No. 3 and No. 5, respectively, to which have been added a neutral density of 0.50 (transmission 32%). The neutral density increases the required exposure without affecting the color rendering produced by the filter, and makes possible the outdoor use of lens apertures similar to those used indoors. In this way, the increased depth of field brought about by smaller apertures is avoided, and the image quality of exterior scenes is more nearly comparable with that of interior scenes. These combination

filters are particularly useful in photographing scenes in which the illumination is high and the subject contains highly reflecting surfaces such as are encountered in street scenes, open desert, and the like.

Wratten No. 12 (Minus Blue): A yellow filter which is slightly lighter than the No. 15. It is useful for the elimination of haze in aerial cinematography and for other work in which a filter intermediate between the No. 5 and No. 15 may be desirable.

Wratten No. 15 (G): A strong yellow filter which absorbs the blue and violet entirely, and a portion of the blue-green, the absorption extending to a wave length of 500 millimicrons (Figure 5). It is used where a darker rendering of blue than that obtained with the No. 5 is necessary. The increase in contrast obtained with this filter makes it very suitable for open landscape work where the space devoted to the sky is

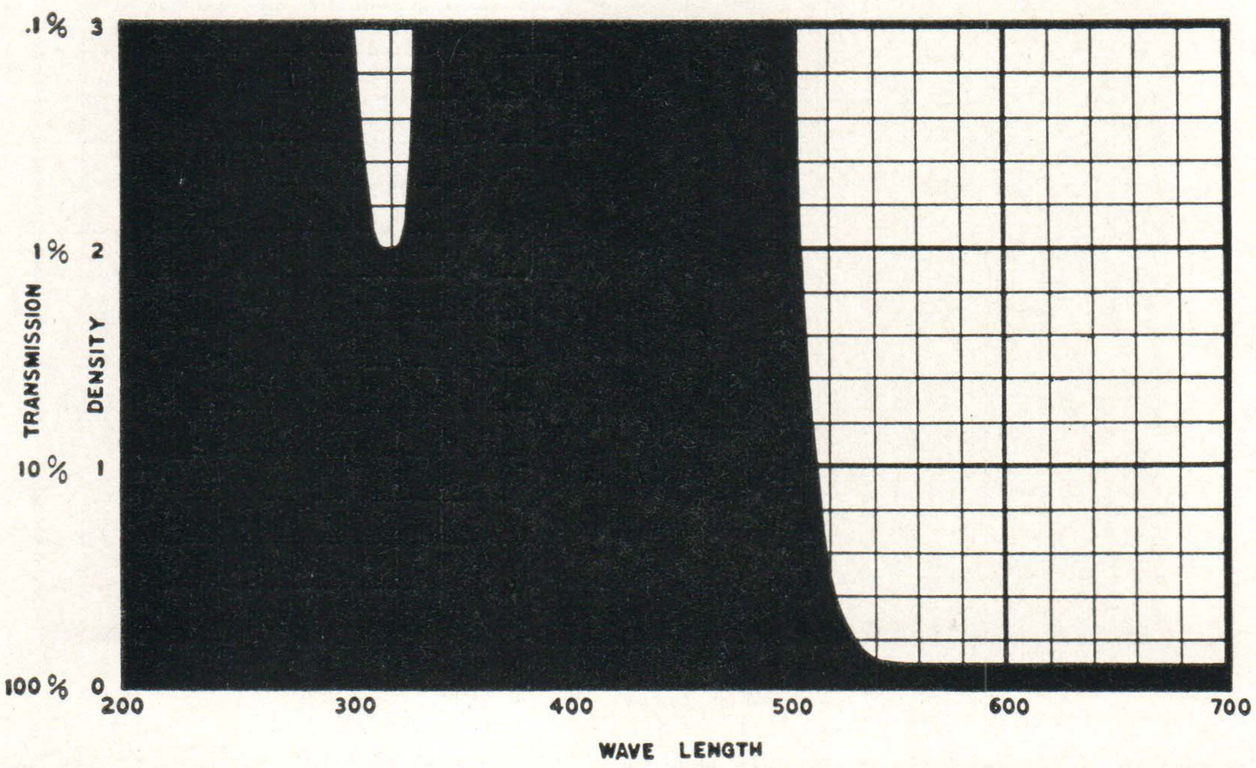


Figure 5. Absorption curve of the Wratten No. 15 (G) Filter

considerable. The G filter darkens the sky, bringing out clouds, and making the foreground stand out in better relief. In marine scenes, the water is darkened and the contrast between the water and objects on the surface is increased.

Wratten No. 21: An orange filter intermediate between the No. 15 and No. 23A. It is useful for bringing out clouds and penetrating haze. Normal panchromatic make-up is lightened slightly.

Wratten No. 23A: A light red filter which absorbs the blue-violet and most of the green, the absorption being practically complete for wave lengths shorter than 560 millimicrons (Figure 6). It is particularly useful for scenic and cloud effects, as well as for seascapes. With the No. 23A, a dark sky can be produced without lightening the foreground to an objectionable extent, although the normal panchromatic make-up is lightened slightly.

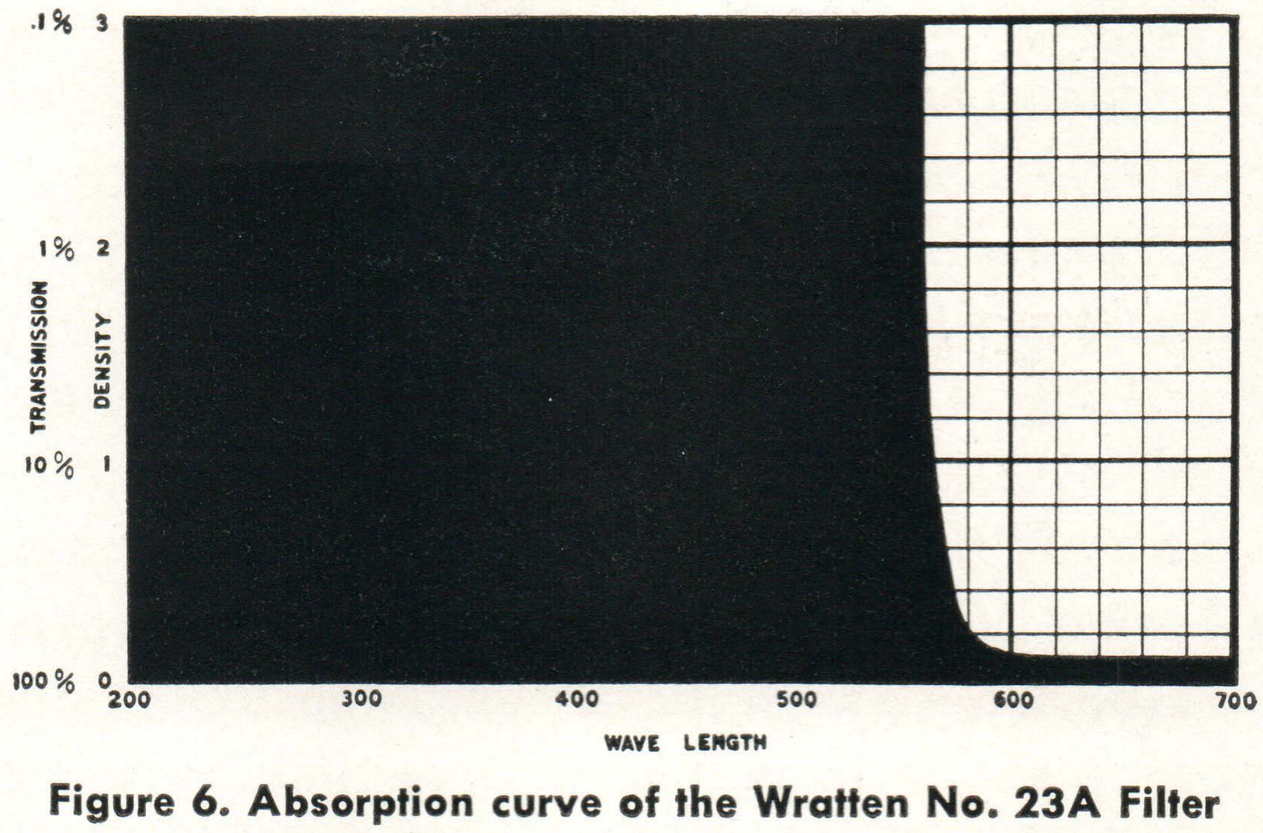


Figure 6. Absorption curve of the Wratten No. 23A Filter

Wratten No. 25 (A): This is the standard tricolor red filter. In motion picture work it is used to obtain even stronger effects than those produced by the No. 23A. It is also used to absorb blue and green light in exposing Infrared, Type *1210*. Special make-up is necessary if faces show in the scene.

Wratten No. 29 (F): A deep-cutting red filter used with panchromatic or infrared-sensitive film for full night effects in strong sunlight. Special make-up is necessary if faces show.

Wratten No. 72: A red filter used almost exclusively for producing night effects by sunlight with panchromatic films. The absorption is complete up to a wave length of 590 millimicrons (Figure 7). Since Eastman picture negative materials, with the exception of Infrared, Type *1210*, are comparatively insensitive beyond 660 millimicrons, the effective sensitivity is for all practical purposes confined between the wave lengths 590 and 660 millimicrons. The night effects produced with the No. 72 are more natural than those made with the No. 29, especially in close-ups. No special make-up is necessary.

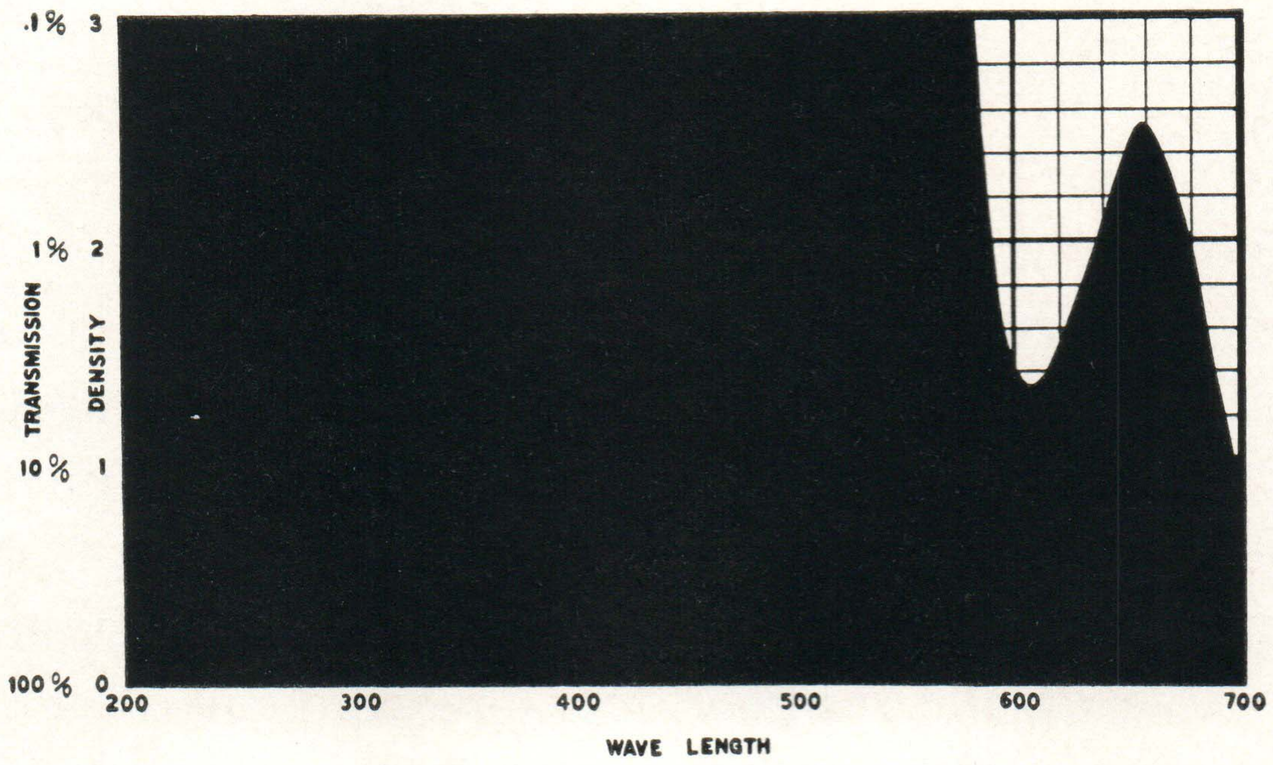


Figure 7. Absorption curve of the Wratten No. 72 Filter

Wratten No. 96 (Neutral Density): This filter, which is available in a number of density values, does not affect the spectral composition of the exposing light, and hence does not alter color rendering. It is used to increase the exposure required so that larger lens stops can be used to throw the background out of focus and concentrate attention on the essential action. Heavy neutral density filters are used occasionally in industrial work when extremely brilliant subjects, such as blast furnaces or arc welding operations, are to be photographed.

Kodak Pola-Screen. Taking advantage of the common occurrence of partially plane-polarized light in nature, the Pola-Screen forms a very useful supplement to the regular color filters. It provides a means of subduing undesirable reflections from non-metallic surfaces (such as glass, water, wood, etc.), and controlling the brightness of the sky. In both of these applications, the effect can be varied simply by rotating the Pola-Screen.

The use of a Pola-Screen for controlling the brightness of the sky has a number of advantages over the use of color filters: (1) The color rendering of objects in the foreground is not altered. (2) The effect produced by the Pola-Screen is easily determined from the appearance of the image on the focusing screen. (3) Filters can be used with the Pola-Screen to control the color rendering of objects in the foreground, while the brightness of the sky is controlled independently by the Pola-Screen.

FILTER FACTORS

Since a filter absorbs part of the light which would otherwise go towards exposing the film, its use involves an increase in exposure corresponding to the proportion of the effective light absorbed. The number of times the exposure must be increased is known as the filter factor.

The filter factor depends principally on the absorption characteristics of the filter, the spectral sensitivity of the photographic material, and the spectral composition of the light by which the subject is illuminated. Factors to sunlight for most of the filters mentioned above are given in the table on the following page.

The filters most generally used for night effects on day exteriors are the No. 72 and occasionally the combination of the No. 23A and No. 56. When used for such work, these filters do not have definite factors, since the increase in exposure necessary varies with the effect to be produced. The exposures should be increased about fifteen and six times, respectively, depending on the shadow detail required and whether booster lights or reflectors are used.

FILTER EXPOSURE TABLE

The table below provides a useful guide to the relative apertures necessary when the standard types of filters are used with the Eastman panchromatic picture negative films:

Eastman Background Panchromatic Negative Film, Type *1213*
Eastman Background-X Panchromatic Negative Film, Type *1230*
Eastman Plus-X Panchromatic Negative Film, Type *1231*
Eastman Super-XX Panchromatic Negative Film, Type *1232*
Eastman Panchromatic Negative Safety Film, Type *5240* (16-mm.)
Eastman Super-XX Panchromatic Negative Safety Film, Type *5242* (16-mm.)

For the purpose of assigning filter factors, all of these materials can be considered as having similar panchromatic sensitivity. The filters listed in the table are those most used in straight exterior photography; filters for night effects and other special subjects are not included.

FILTER EXPOSURE TABLE

To Sunlight

No Filter	*Aero 1*	*Aero 2 ND .30*	*Minus Blue No. 12 Pola-Screen Type IA*	*G No. 15*	*No. 21*	*3N5, 23A Pola-Screen Type I ND .60*	*5N5*	*A No. 25*	*F No. 29*
Factor ▸	*1.5*	*2.0*	*2.5*	*3*	*3.5*	*4*	*5*	*7*	*15*
2.3	1.8								
2.8	2.3	2.0	1.8	1.6	1.5	1.4			
3.2	2.6	2.3	2.0	1.8	1.7	1.6	1.4		
4.0	3.2	2.8	2.5	2.3	2.1	2.0	1.8	1.5	
4.5	3.7	3.2	2.8	2.6	2.4	2.3	2.0	1.7	
5.6	4.5	4.0	3.5	3.2	3.0	2.8	2.5	2.1	1.4
6.3	5.2	4.5	4.0	3.6	3.4	3.2	2.8	2.4	1.6
8	6.5	5.7	5.1	4.6	4.3	4.0	3.6	3.0	2.0
9	7.3	6.4	5.7	5.2	4.8	4.5	4.0	3.4	2.3
11	9.0	7.8	7.0	6.3	5.9	5.6	4.9	4.2	2.8
12.5	10.2	8.8	7.9	7.2	6.7	6.3	5.6	4.7	3.2
16	13.0	11.3	10.0	9.2	8.5	8.0	7.2	6.0	4.1
18	14.7	12.7	11.4	10.4	9.6	9.0	8.0	6.8	4.6
22	18.0	15.6	13.9	12.5	11.7	11.0	10.0	8.3	5.6

In use, the table is extremely simple. Suppose that the Wratten G (No. 15) Filter is to be used in photographing a given scene, and *f*/5.6 is the aperture required for exposure without a filter. Select in the first column under the heading "No Filter" the value 5.6 and follow across the table in the line showing this value until the column headed "G No. 15" is reached. At this point the value 3.2 is found. This indicates that the required aperture for exposure with the Wratten G Filter is *f*/3.2.

Outline of Processing

DEVELOPER COMPOSITION

DEVELOPER formulas should be chosen with the characteristics of the film and of the desired results in mind. In general, the best photographic quality and the most accurate control of this quality are obtained by using a low contrast developer of the Kodak D-76 type for negative films, and a high contrast developer of the Kodak D-16 type for positive films. For variable density sound records, a developer of very low activity is required, either a very dilute developer or a well-buffered developer of low alkalinity such as Kodak D-103.

The Kodak Developer SD-21 used in determining the sensitometric curves and other data on a number of the Specification Sheets is a modification of Kodak D-76. It is obtained by the addition of 6 grams of borax, 8 grams of boric acid, and 0.25 gram of potassium bromide to each liter of D-76 solution. This developer represents a "seasoned" D-76 and gives photographic results closely matching those given by Kodak D-76 after the latter has been conditioned by use. The sensitometric results obtained with Kodak SD-21 therefore approximate more nearly those given by the partially exhausted developers used in practice. The formula is given here only for the purpose of specifying testing conditions and is not intended as a recommendation for commercial laboratory use.

It was not found necessary to modify Kodak D-16 or Kodak D-103 for sensitometric testing. These developers, when freshly mixed and used in small capacity laboratory equipment, produce results which are representative of those obtained by commercial processing.

None of the formulas mentioned here is proposed as a standard for the development of Eastman Motion Picture Films. The choice of a negative formula is determined by the activity, graininess characteristics, and exhaustion life. With positive formulas, the stability and suitability for replenishment are the major determining factors.

CONTROL OF DEVELOPMENT

To insure uniformity of results, the temperature of the developer solution should be controlled to within 0.5°F. of the temperature adopted as the laboratory standard. Many commercial motion picture laboratories are finding it feasible and profitable in terms of consistent quality to control temperatures to within 0.25°F. or even less.

Whenever possible, the temperature of the processing solutions should be held at 65° to 70°F. by some method of temperature control. When this is not practical, and it is necessary to work at temperatures much above normal, the precautions described on pages 27-29 should be taken to avoid excessive swelling and softening of the emulsion.

Times of development cannot be specified because of the dissimilarity of various types of continuous processing machines. The footage speed, extent of exhaustion, rate of circulation of the developer, and degree of agitation all have profound effects on the time of development and may also affect the characteristic curve shapes obtained. Recent design, employing a high degree of agitation and steady spraying or flowing of the solution directly on the film, has still further increased the diversity of equipment in use.

In order to prevent day to day variation in quality, it is extremely important to maintain the correct chemical condition of the developer solution. To insure the production of constant density and gamma for a given time of development, accurate sensitometric control is necessary. Chemical analysis is also very desirable, since it is of great assistance in establishing correct replenishment rates and determining the underlying causes of any variation which may be encountered. A short bibliography on the chemical analysis of developers follows:

ATKINSON, R. B., and SHANER, V. C.: "Chemical Analysis of Photographic Developers and Fixing Baths," *J. Soc. Mot. Pict. Eng.*, **34,** 485 (May, 1940).

EVANS, R. M., HANSON, W. T., JR., and GLASOE, P. K.: "Iodide Analysis in an MQ Developer," *J. Soc. Mot. Pict. Eng.*, **38,** 180 (February, 1942).

EVANS, R. M., HANSON, W. T., JR., and GLASOE, P. K.: "Synthetic Aged Developers by Analysis," *J. Soc. Mot. Pict. Eng.*, **38,** 188 (February, 1942).

STOTT, J. G.: "The Application of Potentiometric Methods to Developer Analysis," Paper presented at the 1942 Spring Meeting of the Society of Motion Picture Engineers at Hollywood, California.

FIXING

The Kodak Fixing Bath F-25, an acid hardening fixing bath containing potassium alum and boric acid, has a very low sludging tendency and a long hardening life. It is recommended for general use.

In some laboratories, fixing baths containing chrome alum are preferred. A suitably compounded chrome alum bath, such as Kodak F-23,

gives a greater degree of hardening than that obtained with potassium alum baths, but the decline in hardening power with exhaustion is more rapid unless the bath is suitably replenished. The degree of hardening produced by a potassium alum bath is usually sufficient; however, if the processing conditions are such that the wash water is warm, or rapid drying at high temperatures is necessary, the use of Kodak F-23 may be desirable.

In any case, the time of fixation should be at least double that required to clear the film. Since the time of clearing depends on the nature and thickness of the emulsion, the degree of agitation during fixing, and the composition, temperature, and degree of exhaustion of the fixing bath, it is not possible to specify fixing times. In general, fine-grained emulsions fix more rapidly than those composed of coarser grains. With materials such as Fine Grain Release Positive, Type *1302*, Fine Grain Panchromatic Duplicating Negative, Type *1203*, and Fine Grain Duplicating Positive, Type *1365*, fixation in a fresh hardening fixing bath should not be unduly prolonged; otherwise a slight reduction of image density may occur.

For maximum permanence, fixation should be carried out in reasonably fresh solutions, and preferably, in two successive fixing baths. When the concentration of silver in the bath becomes excessive, it becomes increasingly difficult to remove silver ions from the film by washing. The exhaustion point at which the concentration of silver becomes excessive can be determined by use of the Kodak Testing Outfit for Acid Stop Baths and Fixing Baths. The maintenance of a low silver concentration by electrolytic silver recovery is conducive to film permanence.

MIXING SOLUTIONS

When photographic solutions are mixed, it is essential that the constituents be dissolved in the proper order if undesirable reactions are to be avoided. In mixing developers, for instance, if the developing agent is dissolved first, and then the alkali is added, considerable aerial oxidation and formation of colored oxidation products may occur before the preservative, sodium sulfite, is dissolved. Kodak formulas are therefore arranged so that the ingredients are named in the order in which they should be dissolved.

A full discussion of the mixing of photographic solutions, including recommendations for mixing large quantities, will be found in *Photographic Chemicals and Solutions*, by J. I. Crabtree and G. E. Matthews, (American Photographic Publishing Company, 1939).

Kodak Developer D-16

For Motion Picture Positive Films

Dissolve chemicals in the order given.	*Avoirdupois*		*Metric*	
Water, about 125°F. (50°C.)	**90**	**gallons**	**750**	**cc.**
Elon	**4¾**	**ounces**	**0.3**	**gram**
Kodak Sodium Sulfite, desiccated	**38**	**pounds**	**38.0**	**grams**
Kodak Hydroquinone	**6**	**pounds**	**6.0**	**grams**
***Kodak Sodium Carbonate, desiccated**	**19**	**pounds**	**19.0**	**grams**
Kodak Potassium Bromide	**14½**	**ounces**	**0.9**	**gram**
Kodak Citric Acid	**11¼**	**ounces**	**0.7**	**gram**
Kodak Potassium Metabisulfite	**1**	**lb. 6½ oz.**	**1.4**	**grams**
Cold water to make	**120**	**gallons**	**1.0**	**liter**

*If monohydrated Kodak Sodium Carbonate is preferred, 1.17 times the quantity should be used.

The citric acid and potassium metabisulfite exert a slight restraining effect, but can be omitted without serious change in the photographic results.

Kodak Developer D-76

For Motion Picture Negative Films

Dissolve chemicals in the order given.	*Avoirdupois*		*Metric*	
Water, about 125°F. (50°C.)	**90**	**gallons**	**750**	**cc.**
Elon	**2**	**pounds**	**2.0**	**grams**
Kodak Sodium Sulfite, desiccated	**100**	**pounds**	**100.0**	**grams**
Kodak Hydroquinone	**5**	**pounds**	**5.0**	**grams**
Kodak Borax, granular	**2**	**pounds**	**2.0**	**grams**
Water to make	**120**	**gallons**	**1.0**	**liter**

The activity of Kodak D-76 can be increased by adding more borax, or decreased by adding boric acid. A fairly wide range of increased or decreased activity can be obtained by varying the relative quantities of borax and boric acid.

Kodak Developer D-103

For Small Scale Development of Variable Density Sound Records

Dissolve chemicals in the order given.	*Avoirdupois*		*Metric*	
Water, about 125°F. (50°C.)	**90**	**gallons**	**750**	**cc.**
Elon	**2**	**pounds**	**2.0**	**grams**
Kodak Sodium Sulfite, desiccated	**100**	**pounds**	**100.0**	**grams**
Kodak Hydroquinone	**5**	**pounds**	**5.0**	**grams**
Kodak Borax, granular	**1**	**pound**	**1.0**	**gram**
***Kodak Boric Acid Crystals**	**15**	**pounds**	**15.0**	**grams**
Kodak Potassium Bromide	**2**	**ounces**	**0.125**	**gram**
Water to make	**120**	**gallons**	**1.0**	**liter**

*Use crystalline boric acid as specified. Powdered boric acid dissolves with great difficulty and its use should be avoided.

This developer keeps well and gives results which match closely those obtained with the developers generally employed in large scale commercial developing machines. In comparison with Kodak D-103, such developers are more dilute and less expensive, but have a shorter life and usually must be discarded daily.

Kodak Hardening Bath SB-3

For use at 65°F. to 75°F.

	Avoirdupois		*Metric*
Kodak Potassium Chrome Alum	**30 pounds**	**4 ounces**	**30.0 grams**
Water to make	**120 gallons**	**1 gallon**	**1.0 liter**

For maximum hardening, film should remain in the hardening bath at least 3 minutes with frequent agitation. An unused bath keeps well, but the hardening properties of a partially used bath decrease rapidly on standing.

With use the hardening properties of the bath decrease as a result of the addition of developer, and sufficient sulfuric acid should be added at intervals to bring the acidity to a pH value of 3.0. At this point maximum hardening is obtained with unrinsed film which has been developed in developers containing an average quantity of alkali (Kodak D-16 or D-76). The amount of acid to be added can be determined by titration, using brom-phenol-blue as the indicator. With care, it is possible to establish a schedule for the addition of acid on a footage basis. If a sludge forms in the bath, or on the film, or the bath ceases to harden after revival with acid, it should be discarded.

When film has been put through a chrome alum hardening or fixing bath, it should be wiped or squeegeed carefully after washing and before drying; otherwise any chromium scum which may have been formed on the film will leave stains. After the film has dried, such stains are almost impossible to remove.

Kodak Hardening Bath SB-4

For use above 75°F.

	Avoirdupois		*Metric*
Kodak Potassium Chrome Alum	**30 pounds**	**4 ounces**	**30.0 grams**
***Kodak Sodium Sulfate, desiccated . . . . . .**	**60 pounds**	**8 ounces**	**60.0 grams**
Water to make	**120 gallons**	**1 gallon**	**1.0 liter**

*If the crystalline salt is preferred, use 2¼ times the quantity.

Agitate the film for 30 to 45 seconds when it is first immersed in the hardener, or streakiness will result. Leave the film in the bath for at least 3 minutes between development and fixation. If the temperature is below 80°F. (26°C.), rinse for 1 or 2 seconds in water before immersing in the hardening bath.

The hardening bath is a violet-blue color by tungsten light when freshly mixed, but it ultimately turns yellow-green with use; it then ceases to harden and should be replaced with a fresh bath. The hardening bath should never be overworked. An unused bath keeps well, but the hardening properties of a partially used bath decrease rapidly on standing.

Kodak Fixing Bath F-23

Chrome Alum: For Motion Picture Films

Solution A

Dissolve chemicals in the order given.	*Avoirdupois*		*Metric*
***Kodak Sodium Thiosulfate (Hypo)**	**240 pounds**	**2 pounds**	**240.0 grams**
Kodak Sodium Sulfite, desiccated	**12½ pounds**	**1 oz. 290 grains**	**12.5 grams**
Water to make	**90 gallons**	**96 ounces**	**750.0 cc.**

Solution B

Water	**21 gallons**	**20 ounces**	**150 cc.**
Kodak Sodium Sulfite, desiccated	**5 pounds**	**290 grains**	**5.0 grams**
****Sulfuric Acid (5% solution)**	**4¾ gallons**	**5 fl. oz.**	**40.0 cc.**
Kodak Potassium Chrome Alum	**32 pounds**	**4¼ ounces**	**32.0 grams**
Water to make	**30 gallons**	**32 ounces**	**250.0 cc.**

*A bath which fixes more rapidly can be obtained by increasing the hypo concentration to 2½ pounds per gallon (300 grams per liter).

**To prepare 5% sulfuric acid, add 1 part by volume of Kodak Sulfuric Acid C.P. (concentrated) to 19 parts by volume of cold water, slowly with stirring. The acid must be added to the water; otherwise the solution may boil with explosive violence and if spattered on the hands or face will cause serious burns.

Solutions A and B must be cooled to about 70°F. before they are mixed in order to avoid sulfurization. Add Solution B to Solution A while stirring the latter thoroughly. It is not desirable to store Solution B as a stock hardener, because it loses its hardening properties on keeping.

The hardening properties fall off rapidly with use, and sulfuric acid should be added at regular intervals to maintain the proper acidity. The quantity required can be determined by titrating 30 cc. of the fixing bath with a 2.5% solution of sulfuric acid, using brom-phenol-blue as the indicator. Sufficient acid should be added to change the color of the solution to yellow.

Kodak Fixing Bath F-25

For Motion Picture Films

Dissolve chemicals in the order given.	*Avoirdupois*		*Metric*
Water, about 125°F. (50°C.)	**60 gallons**	**64 ounces**	**500 cc.**
Kodak Sodium Thiosulfate (Hypo)	**300 pounds**	**2 lbs. 8 ounces**	**300.0 grams**
***Kodak Sodium Sulfite, desiccated**	**5 pounds**	**290 grains**	**5.0 grams**
Kodak Acetic Acid (glacial)	**1 gal. 22 ounces**	**1¼ fl. oz.**	**10.0 cc.**
****Kodak Boric Acid, crystals**	**5 pounds**	**290 grains**	**5.0 grams**
Kodak Potassium Alum	**10 pounds**	**1 oz. 145 grains**	**10.0 grams**
Water to make	**120 gallons**	**1 gallon**	**1.0 liter**

*This bath contains a minimum quantity of sulfite and is satisfactory for use at 65° to 70°F. (18° to 21°C.) if kept not longer than 3 or 4 weeks. If the temperature is apt to rise above 70°F. (21°C.) the quantity of sulfite should be doubled.

**Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

Dissolve the hypo in one-half the total volume of water and add the remaining chemicals in the order given after dissolving each in a small quantity of water. Dilute to the required volume.

Revival is unnecessary with this fixing bath since its hardening properties and freedom from sludge are maintained throughout the useful life (about 400 feet per gallon). Unless the developer is excessively alkaline, the degree of alkalinity of the fixing bath can be determined by adding 1.0 cc. of a 0.04% solution of brom-cresol-purple to a 10.0 cc. sample of the fixing bath. The color, which is yellow when the bath is fresh, deepens during exhaustion and reaches a distinct reddish tint when the bath is exhausted. This occurs at a pH value of approximately 5.6, and although the bath will still harden, it should be discarded because most of the acid has been neutralized and further exhaustion may lead to developer stains.

Tropical Use

SPECIAL PRECAUTIONS *are necessary in the packing, handling, and processing of motion picture film used in tropical regions where high temperatures and humidities are likely to prevail. The following sections contain what is believed to be the best information available on the care necessary under these conditions.*

SPECIAL TROPICAL PACKING

MOTION picture film is comparatively safe from deterioration while it remains in the container as originally packed. Once the container has been opened, however, moisture may be admitted even if the container is immediately resealed, and the future condition of the film becomes uncertain. Experienced travelers and explorers, and others who use film under tropical conditions, adopt a unit system of packing and avoid opening any of the containers until the film is required for use.

The unit system of packing supplied on special order by the Eastman Kodak Company is illustrated in Figure 8. It employs a series of three containers, each larger unit containing one or more smaller units as follows:

First Unit. This is the regular type of taped metal film can, to which is added a tape strap for convenience in handling. The cans hold the length taken by the camera—100, 200, 400, or 1,000 feet.

Second Unit. This is a larger metal container, lined with corrugated strawboard, hermetically sealed, and equipped with a rip strip and ring so that it can be opened without tools. The second unit, which may contain either 1 or 5 first unit cans, is packed in a heavy strawboard carton. When small quantities of film are to be used at one time, it is advisable to have a few second unit cans containing single first unit cans. While such second unit cans require somewhat more space, their use prevents the needless unpacking of large numbers of first unit cans.

Cartons containing five rolls, packed as above, are of the following approximate sizes and weights:

Length of Roll	*Total Footage*	*Dimensions (Inches)*	*Weight*
100 feet {No. 10 Spool}	500 feet	5 3/8" x 5 3/8" x 10 1/8"	6.9 pounds
200 feet	1,000 feet	6 5/8" x 6 5/8" x 10"	8.6 pounds
400 feet	2,000 feet	8 9/16" x 8 9/16" x 10"	16 pounds
1,000 feet	5,000 feet	12 1/4" x 12 1/4" x 10 1/8"	37 pounds

Third Unit. This is a heavy wooden case lined with a waterproofed paper liner which can be sealed with an asphalt compound. Either a single or a double thickness liner is supplied, depending on requirements. In either case, when the liner is sealed, it forms a complete covering for the second unit packages. In some instances an additional liner of an

Figure 8. Packing units for tropical shipment as supplied by the Eastman Kodak Company (showing 5-roll container for 1000-foot cans, special container for sheet film, fiber carton, and double-lined shipping case)

insulating material, such as insulite, may be useful in order to minimize the effect of extreme temperature changes. Normally, such extra insulation is not considered necessary.

Consideration should be given to the size of the third unit to avoid difficulties on extended journeys where these units are to be transported by hand or on pack animals. Some idea of the weight and size can be obtained from the following approximate measurements for a case containing six 5-roll units, no allowance being made for extra insulation.

Length of Roll	*Total Footage*	*Dimensions (Inches)*	*Weight*
100 feet {No. 10 Spool}	3,000 feet	18¼″ x 11¾″ x 11½″	52 pounds
200 feet	6,000 feet	22″ x 14⅜″ x 11¼″	66 pounds
400 feet	12,000 feet	25⅝″ x 18¼″ x 11½″	185 pounds
1,000 feet	30,000 feet	39¾″ x 25¾″ x 11½″	265 pounds

The spaces left in the larger third unit can well be used to store extra quantities of adhesive tape and black photographic paper for repacking the containers, as well as for other photographic supplies used on the trip, such as roll film, sheet film, etc. Photographic materials should be kept separate from other supplies. Chemicals, especially, should not be packed in cases containing film.

The following information should be given when ordering film for tropical use: (1) Type of camera. (2) Method of winding peculiar to the particular camera in use, including description of camera magazine core. (3) Type of film desired. (4) Length of rolls. (5) Method of packing desired, including number of rolls in a second unit can, and number of cans in a case. (6) Quantities of other materials to be packed in a case.

TROPICAL HANDLING AND EXPOSURE

Humidity has a considerably greater influence than temperature on the keeping properties of most photographic emulsions. Changes in emulsion characteristics or in the latent image occur only slowly at low relative humidities (20 to 30%) but may be extremely rapid at high humidities. At 95% relative humidity, as short a storage period as one week at 95°F. may produce an appreciable effect. It is essential, therefore, that film be kept dry before, during, and after exposure, and that excess moisture which may have been absorbed be removed.

Since high temperatures aggravate the bad effects of high humidities on photographic quality, every precaution should be taken to store the film in a cool place. In desert country, where objects in the sun often become extremely hot, bedding and other insulation can be piled over

the film boxes to keep them cool. Unventilated buildings should be avoided since the temperatures inside them may be especially high. In any case, an effort should be made to chill the film as much as possible during the cool nights so that the effects of high temperatures during the day are minimized. In permanent stations, the use of storage pits may help to secure a lower and more uniform temperature.

Keeping Before Exposure. It is well to open only one of the third unit cases at a time, carefully protecting its contents from moisture, and preserving the metallic seal of the secondary packing units as long as possible. Film in taped cans, while fairly well protected, may gradually acquire moisture through a "breathing" process due to temperature and pressure changes. Consequently, if the secondary container is opened more than a week or two before the individual cans are used, precautions should be taken to protect the latter from moisture.

As soon as the film has been taken from the inner first unit, it is liable to much more rapid deterioration. Care should therefore be exercised not to load film into the camera magazine any longer in advance of use than is absolutely necessary. This precaution is doubly important in steamy locations.

Precautions against exposure of the film to the atmosphere should also be taken when photographic work is done near salt water. Contact with the saline matter which is carried in suspension in the air may cause rapid deterioration of the film emulsion.

Exposure. The contrast of a scene photographed in the tropics may vary considerably, depending upon atmospheric conditions. Under dry tropical conditions, the extreme clarity of the atmosphere gives rise to very brilliant highlights and very deep shadows. Under wet tropical conditions, on the other hand, the particles of moisture in the air scatter a considerable amount of light into the shadows, diminishing the brightness range of the subject to a marked degree. In order to make sure of obtaining the desired effects, it is therefore necessary to take into account the unusual character of the lighting, regardless of the method used for calculating exposure.

Although it has been suggested in the past that films to be held for some time before processing should be given increased camera exposure, it appears that with modern types of negative materials, the exposure should be normal, or even somewhat below normal, if processing does not follow soon after exposure. The reason for this recommendation is that the latent image change during storage before processing, with practically all negative materials, involves an increase in the lower densities of the characteristic curve, some lowering of contrast through-

out the straight line portion, and frequently a decrease in the higher densities. Such changes in the latent image require an increase in developing time to maintain adequate contrast, and if overexposure occurs in the camera, negatives of high density and graininess will result. If the overexposure is excessive, the predominant part played by the shoulder of the characteristic curve will have an extreme flattening effect on the negatives.

Keeping After Exposure. Since the moisture picked up by the film while in the camera can be responsible for a noticeable loss of quality in the resulting pictures, the film should be removed from the camera as soon as possible after exposure. Unless it is to be developed within a day or so, it should be dried out as thoroughly as possible. This will serve to retard latent image changes, as well as to prevent the possible formation of moisture spots.

Film which has absorbed only a small amount of moisture can be dried satisfactorily by repacking it in dried black photographic paper and resealing it with tape in the original first unit container. The black photographic paper, which is chosen for this purpose because it contains no chemicals harmful to the film, should be dried before use in an oven or over a fire. Repacking of the film at intervals with freshly dried paper is desirable.

A far more powerful desiccant is *silica gel*, which is employed in an 8 to 20 mesh grade. Previous to use, it should be dried by strong heating (to 400°F. or more, with stirring) and cooled in a closed container to prevent reabsorption of moisture. Silica gel can be used conveniently in the lower half of a two-compartment drying can, consisting of two ordinary film cans soldered bottom to bottom and connected by perforations. A piece of finely woven cloth or blotting paper should be placed over the perforations to prevent dust from reaching the film.

The large quantity of desiccants required for drying film is not usually recognized. Although smaller quantities are adequate for lesser amounts of moisture, complete drying of film saturated with moisture requires from one to two pounds of silica gel per 1000 feet.

Rice (dried by heating to a faint brown) and tea leaves are other useful drying agents which are likely to be available in many tropical locations; about five pounds of either per 1000 feet of film will effect reasonable drying. Any of these drying agents should be left with the film for several days, depending on the quantity of moisture in the film and the tightness of the roll.

Although calcium chloride is a satisfactory desiccant if carefully used, it is no longer recommended because experience has shown that

its chemical activity and tendency to become liquid under humid conditions are apt to cause trouble. In practice, silica gel has proved preferable.

Silica gel, rice, or tea leaves should be used only in the drying cans and, because of the danger of spots due to dust on the emulsion, *should not be shipped with the film.* Before shipping, the dried film should be removed from the drying can and rewrapped in dry black photographic paper. It can then be returned to its original first unit can and sealed with adhesive tape. The second unit cans should be resealed with solder only after their contents have been satisfactorily dried.

TROPICAL PROCESSING

Processing of motion picture film at high temperatures is not recommended, and because of the exacting standards of uniformity imposed by the motion picture industry, very little processing work is done in the field. However, when development is necessary and adequate cooling is not available, the following solutions and processing procedure are applicable.

Solutions Employed

Negative Developer. Kodak D-76 is available in packaged units to make 1 or 10 gallons, or it can be mixed from the formula on page 19. To prevent swelling of the emulsion at high temperatures, the developer should be modified by the addition of 50 or 100 grams per liter (6¾ or 13¼ ounces per gallon) of desiccated sodium sulfate, as described on page 28. If the developer is diluted for use, the specified quantities of sodium sulfate should be added per unit of working solution and the time of development increased to maintain proper contrast. Kodak Replenisher D-76R for Kodak Developer D-76 is available in packaged units to make 1 or 5 gallons; sodium sulfate should be added to the replenisher in the same proportion that it is added to the developer.

The Kodak Tropical Developer, available in packaged units to make 1 gallon, is also suitable for the development of negative films. This developer is specially designed for tropical work and does not require the addition of sodium sulfate before use.

Positive Developer. Kodak D-16 is available in packaged units to make 10 gallons, or it can be mixed from the formula on page 19. To prevent swelling of the emulsion at high temperatures, Kodak D-16 should be modified by the addition of 100 or 150 grams per liter (13¼ or 20 ounces per gallon) of desiccated sodium sulfate, as described on the following page.

Hardening Bath. The addition of sodium sulfate to the developer protects the film only against swelling during development. To prevent softening of the emulsion in the wash water, the use of an effective hardening bath is necessary between development and fixation. Either Kodak SB-4 (formula on page 20) or Kodak Tropical Hardening Powders (available in packaged units to make 1 gallon) can be used. These are chrome alum hardeners and should be discarded when the color changes with use from violet-blue to yellow-green.

Fixing Bath. An acid hardening fixing bath such as Kodak F-25 (formula on page 21) is suitable for use after the chrome alum hardener. In packaged form, Kodak Single Solution Hardener and Fixer is available in units to make 1 gallon.

Processing Procedure

Develop the film in a solution selected from the following table according to the working temperature obtainable. The choice of time depends on the conditions of development and the effect desired.

Temperature	*Developer*	*Sodium Sulfate (Desiccated) Grams per Liter*	*Approximate Time of Development**
65°F.	D-76	0	8 - 12 min.
75°F.	D-76	0	6 - 9 min.
75°F.	D-76	50	8 - 12 min.
85°F.	D-76	50	6 - 9 min.
85°F.	D-76	100	8 - 12 min.
95°F.	D-76	100	6 - 9 min.
65°F.	D-16	0	4 - 8 min.
75°F.	D-16	0	3 - 6 min.
75°F.	D-16	100	4 - 8 min.
85°F.	D-16	100	3 - 6 min.
85°F.	D-16	150	4 - 8 min.
95°F.	D-16	150	3 - 6 min.

*The range of development time given is sufficient to permit the processing of various Eastman Motion Picture Films.

The film should preferably be rinsed in water after development to prevent scumming in the hardening bath, but this rinse should be limited to a very brief period (about 2 seconds). Omit the water rinse above 80°F. Harden the film in Kodak Hardener SB-4 or a bath made from the Kodak Tropical Hardening Powders for 3 minutes with vigorous agitation during at least the first 30 seconds. Then fix for about 5 minutes.

It is desirable to keep all solutions, including the wash water, at the same temperature. Otherwise sudden changes of temperature may

cause reticulation or, in less severe cases, a type of incipient reticulation which gives the appearance of graininess.

The film should be washed in running water, but if this is not available, temporary protection can be given by three changes of water, each of 5 minutes duration. In either case, the temperature of the wash water should not exceed 95°F. Thorough washing at 65° to 70°F. should be given later if a temporary wash has been necessary.

The processed film can be given some protection against the action of molds or bacteria by bathing it in a 0.25% solution of salicylic acid before drying.

Drying should be as rapid as possible, but heated air should be used only if effective hardening has been obtained. In general, the dry bulb temperature should not exceed 110°F., although a dry bulb temperature of 120°F. can be used provided the film is well hardened.

In damp tropical regions, drying is slow because of the nearness of the dry bulb temperature to the wet bulb temperature. Increased velocity of air is very helpful, but must be avoided if much dust is present in the air. Insects can be eliminated by the use of netting.

If filtration and circulation of the drying air is practicable, a bed of silica gel can be used to dehumidify the air. The silica gel can be regenerated at intervals by heating as described on page 26.

A short bibliography on tropical use and processing of films and on small scale or field processing follows:

CRABTREE, J. I.: "Handling Motion Picture Film at High Temperatures." *Trans. Soc. Mot. Pict. Eng.*, **No. 19,** 39 (1924).

COWLING, H. T.: "Film Care in the Tropics," *Trans. Soc. Mot. Pict. Eng.*, **No. 30,** 250 (1927).

CRABTREE, J. I.: "A Portable Apparatus for Developing Motion Picture Film at High Temperatures," *Brit. J. Phot.*, **65,** 379 (1918).

CRABTREE, J. I.: "The Development of Motion Picture Film by the Reel and Tank Systems," *Trans. Soc. Mot. Pict. Eng.*, **No. 16,** 163 (1923).

Physical Characteristics

FILM BASE

WITH THE exception of release positive, leader, and 16-mm. materials, Eastman Motion Picture Films are regularly available only on cellulose nitrate base. Release positive films and leader stock are available on either cellulose nitrate or cellulose acetate (safety) base, while 16-mm. films, in accordance with regulations governing their use, are furnished on *safety base only*.

Other 35-mm. emulsions can be obtained on acetate base only on special order. The minimum quantity requirement for such orders is twenty-eight 35-mm. rolls or fifty-six 16-mm. rolls of one listed length, not shorter than 200 feet. This minimum quantity requirement applies also to films regularly supplied in the 16-mm. width when such films are required on acetate base in the 35-mm. width.

The base on which Eastman panchromatic negative emulsions are coated incorporates a gray (for nitrate) or blue-gray (for acetate) dye to prevent halation. Without the dye, light penetrating the emulsion might be reflected at an angle from the back of the base and strike the emulsion again, causing halation around the image of bright objects. With it, light which is not absorbed by the emulsion must undergo the absorptive action of the dye twice in order to get back to the emulsion and cause halation. The dye does not bleach out in the processing solutions, but its presence has no effect on printing quality aside from the increase in printing exposure necessary.

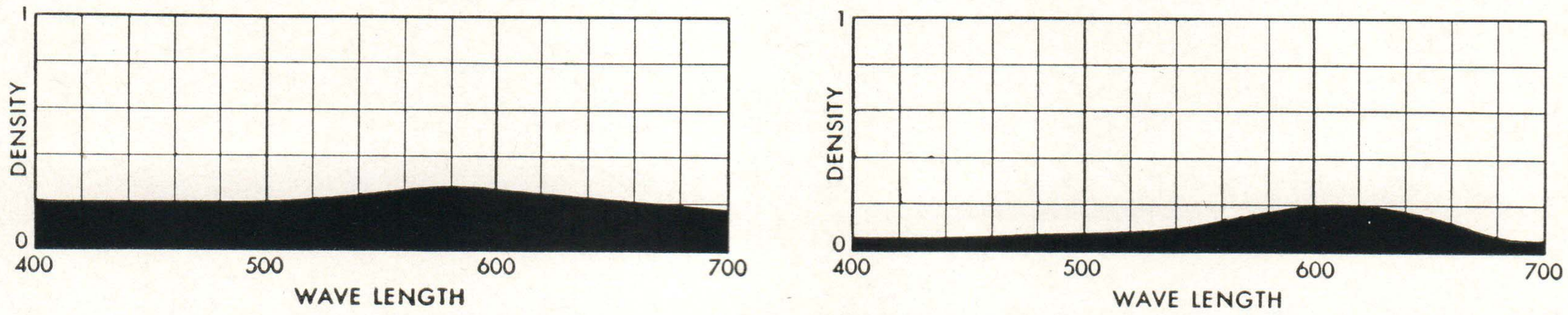


Figure 9. Absorption curves for (left) gray and (right) lavender nitrate bases

For identification purposes, Duplicating Positive, Type *1355*, and High Contrast Duplicating Positive, Type *1362*, are furnished on lavender base. This prevents possible confusion with other positive materials. Spectrophotometric absorption curves for the gray negative base and the lavender duplicating positive base are shown in Figure 9.

A number of tinted base positive films bearing the general names Eastman Sonochrome Positive (emulsion same as Release Positive, Type *1301*) and Eastman Fine Grain Sonochrome Positive (emulsion same as Fine Grain Release Positive, Type *1302*) are available as listed in the table below. The tinted bases cover a variety of hues and include one (Argent) which is a neutral silvery gray.

EASTMAN SONOCHROME AND FINE GRAIN SONOCHROME FILMS

Tint Number	*Name of color*	*Description of color*	*Nitrate*		*Acetate*	
			1301 Em.	*1302 Em.*	*1301 Em.*	*1302 Em.*
2	Peachblow	Flesh pink	*1316*	*1336*	Nitrate only	
4	Firelight	Yellow-orange	*1318*	*1338*	*5318*	*5338*
6	Sunshine	Yellow	*1320*	*1340*	*5320*	*5340*
7	Verdante	Green	*1321*	*1341*	Nitrate only	
12	Purplehaze	Blue-violet	*1326*	*1346*	*5326*	*5346*
16	Inferno	Red-magenta	*1330*	*1347*	*5330*	*5347*
17	Argent	Hueless	*1331*	*1348*	Nitrate only	

When these materials are employed for sound positives, increases in amplification are required to bring the volume up to the level which would be obtained with clear base positive films. In the table below the volume compensation necessary with each base is given in decibels. The values were determined with several types of photocells used extensively in commercial installations and refer to the comparison between the tinted base and clear base of the same composition.

VOLUME COMPENSATION REQUIRED WITH TINTED BASES (Decibels)

Base		*Photocell*			
Tint	*Composition*	*RCA No. 927*	*RCA No. 929*	*RCA No. 921*	*Cetron CE-5AB*
Peachblow	Nitrate	0.3	4.4		
Firelight	Nitrate	0.3	3.9		
Firelight	Acetate	0.3	3.6	0.3	0.4
Sunshine	Nitrate	0.1	2.1		
Sunshine	Acetate	0.1	2.2	0.2	0.2
Verdante	Nitrate	1.4	4.4		
Purplehaze	Nitrate	1.1	4.9		
Purplehaze	Acetate	1.0	4.9	0.8	1.2
Inferno	Nitrate	0.7	7.8		
Inferno	Acetate	0.6	7.9	0.5	0.8
Argent	Nitrate	2.0	3.1		

PERFORATIONS

The cutting and perforating dimensions and tolerances for Eastman Motion Picture Films correspond to the SMPE Recommended Practices shown on the opposite page. The 35-mm. negative perforation type, which is used with films intended for making picture negatives, for duplicating, and for use in certain special processes, is commonly known as Bell & Howell; its continuance is required by existing equipment. The 35-mm. positive perforation type, also known as Kodak Standard, is used with positive and sound recording films.

SHRINKAGE

Both nitrate and acetate base motion picture film tend to swell during processing, to shrink back again during drying, and to continue to shrink at a decreasing rate throughout the life of the film. During the last few years improvements in the manufacture of film base have reduced these effects to about half of their magnitude ten or fifteen years ago.

Shrinkage is divided into two types, permanent (irreversible) and temporary (reversible). Both types are largely dependent on the film base, although the emulsion, since it is considerably more hygroscopic than the base, has a marked influence on reversible shrinkage.

Permanent shrinkage is due to loss of residual solvents, loss of plasticizer, and also, to a slight extent, to the gradual elimination of strains introduced during manufacture or processing. It is accelerated somewhat by high humidities (probably because the diffusion of solvents is aided by the presence of moisture), and to a much greater degree by high temperatures.

The relative humidity of the air in contact with the film is almost the sole factor in determining the moisture content, and this in turn governs the amount of temporary shrinkage or swell. Nitrate film swells approximately 0.06% in length per 10% increase in relative humidity, while acetate film swells about 0.08% for the same increase.

Like most materials, photographic film expands with heat and contracts with cold. Film will expand about 0.05% in length for every 10°F. increase in temperature at constant moisture content. However, it generally happens that the relative humidity drops in cases where film is exposed to heat. Since the effect of humidity is greater than that of heat, the net result is usually a shrinkage.

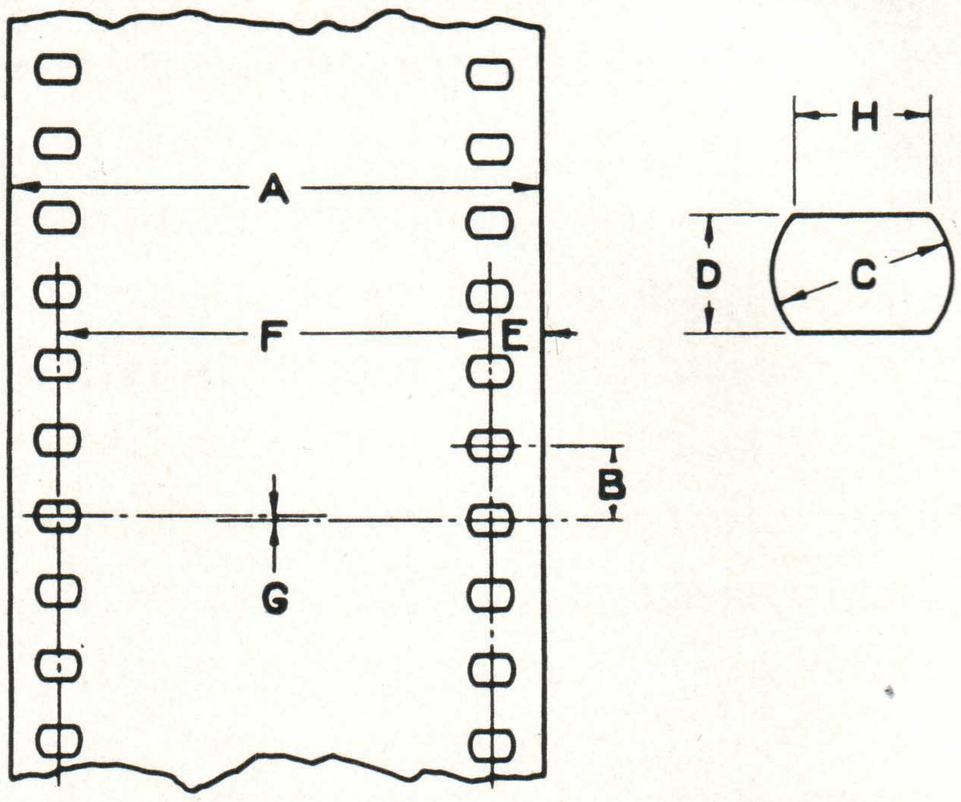
Immediately after slitting and perforating, motion picture film is placed in cans which are taped. Until the film is removed, the gain or loss of moisture or of solvents is extremely low; for 35-mm. film in

Same as‡ ASA Z22.1 1930

SMPE RECOMMENDED PRACTICE
For 35-mm Motion Picture Film

CUTTING AND PERFORATING NEGATIVE RAW STOCK*

SMPE-1
1941



	Millimeters	*Inch Equivalents*
A	35.00 + 0.00 − 0.05	1.378 + 0.000 − 0.002
B	4.75 ± 0.013	0.1870 ± 0.0005
*C***	2.794 ± 0.01	0.1100 ± 0.0004
D	1.85 ± 0.01	0.0730 ± 0.0004
E	3.40 ± 0.05	0.134 ± 0.002
F	28.17 ± 0.05	1.109 ± 0.002
G	Not > 0.025	Not > 0.001
H	2.08 ± 0.025	0.082 ± 0.001
L†	475.00 ± 0.38	18.70 ± 0.015

** Diameter of circle of curvature.
† *L* = length of any 100 consecutive perforation intervals.

* For picture negative and certain special processes.

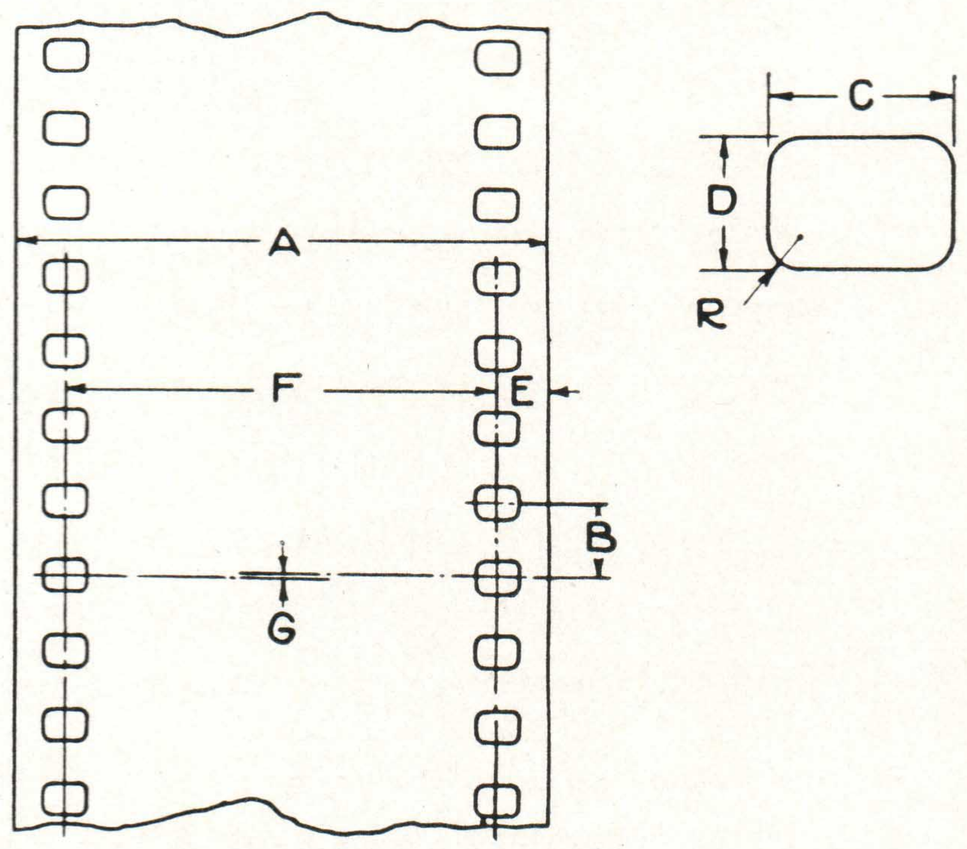
These dimensions and tolerances apply to the material immediately after cutting and perforating.

‡ Except that Z22.1—1930 (see *J. Soc. Mot. Pic. Eng.*, March, 1938, p. 261) was specified for both negative and positive raw stock.

SMPE RECOMMENDED PRACTICE
For 35-mm Motion Picture Film

CUTTING AND PERFORATING POSITIVE RAW STOCK*

SMPE-2
1941



	Millimeters	*Inch Equivalents*
A	35.00 + 0.00 − 0.05	1.378 + 0.000 − 0.002
B	4.750 ± 0.013	0.1870 ± 0.0005
C	2.794 ± 0.01	0.1100 ± 0.0004
D	1.98 ± 0.01	0.0780 ± 0.0004
E	3.40 ± 0.05	0.134 ± 0.002
F	28.17 ± 0.05	1.109 ± 0.002
G	Not > 0.025	Not > 0.001
*L***	475.00 ± 0.38	18.70 ± 0.015
R	0.5	0.020

** *L* = length of any 100 consecutive perforation intervals.

* For positive prints and sound recording.

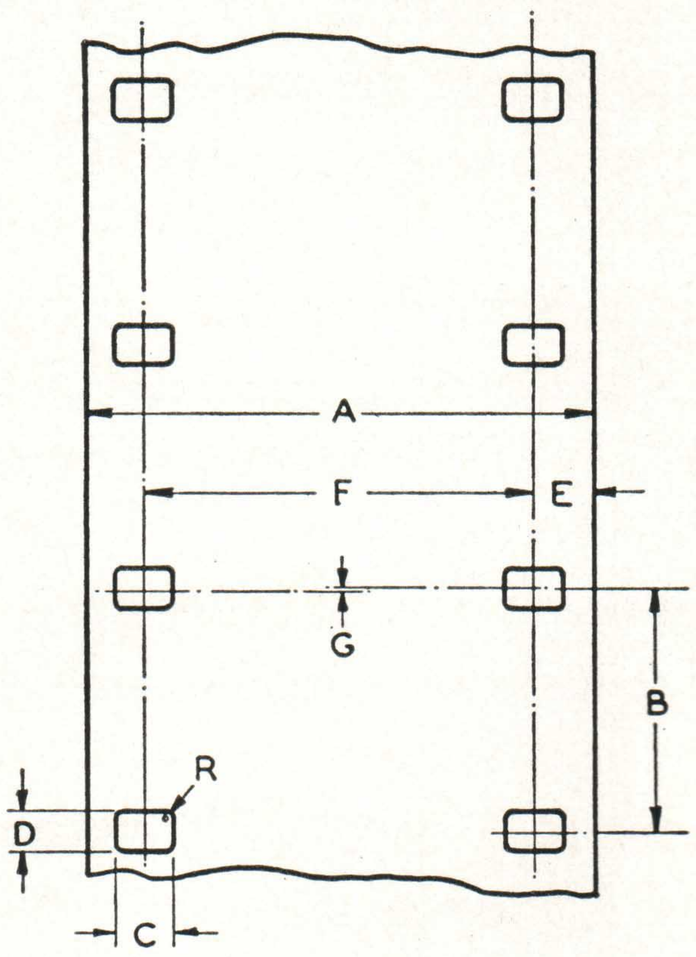
These dimensions and tolerances apply to the material immediately after cutting and perforating.

Same as ASA Z22.5 1941

SMPE RECOMMENDED PRACTICE
For 16-mm Silent Motion Picture Film

CUTTING AND PERFORATING NEGATIVE AND POSITIVE RAW STOCK

SMPE-9
1936



	Millimeters	*Inch Equivalents*
A	16.00 + 0.00 − 0.05	0.630 + 0.000 − 0.002
B	7.620 ± 0.013	0.3000 ± 0.0005
C	1.83 ± 0.01	0.0720 ± 0.0004
D	1.27 ± 0.01	0.0500 ± 0.0004
E	1.83 ± 0.05	0.072 ± 0.002
F	12.320 ± 0.025	0.485 ± 0.001
G	Not > 0.025	Not > 0.001
*L**	762.00 ± 0.76	30.0 ± 0.03
R	0.25	0.010

* *L* = the length of any 100 consecutive perforation intervals.

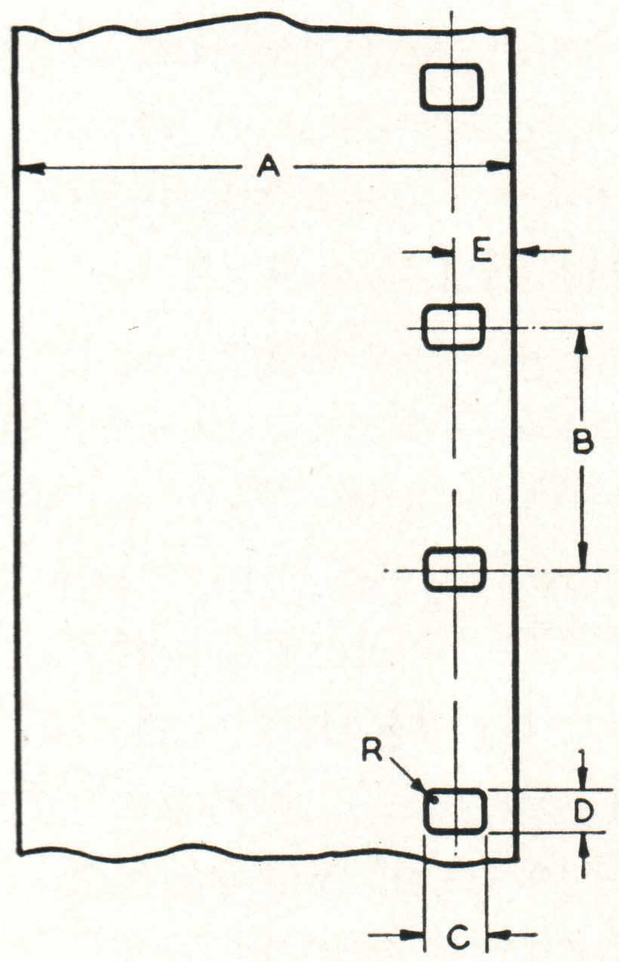
These dimensions and tolerances apply to the material immediately after cutting and perforating.

Same as ASA Z22.12 1941

SMPE RECOMMENDED PRACTICE
For 16-mm Motion Picture Sound-Film

CUTTING AND PERFORATING NEGATIVE AND POSITIVE RAW STOCK

SMPE-16
1936



	Millimeters	*Inch Equivalents*
A	16.00 + 0.00 − 0.05	0.630 + 0.000 − 0.002
B	7.620 ± 0.013	0.3000 ± 0.0005
C	1.83 ± 0.01	0.0720 ± 0.0004
D	1.27 ± 0.01	0.0500 ± 0.0004
E	1.83 ± 0.05	0.072 ± 0.002
*L**	762.00 ± 0.76	30.00 ± 0.03
R	0.25	0.010

* *L* = the length of any 100 consecutive perforation intervals.

These dimensions and tolerances apply to the material immediately after cutting and perforating.

Reprinted from *J. Soc. Mot. Pict. Eng.*, **38**, 406, 407, 414, 421 (May, 1942).

1000-foot cans, the shrinkage will hardly ever exceed 0.1% during four or five months. After exposure, the shrinkage of tightly wound rolls of either nitrate or acetate base film is limited by the long distance moisture must travel to reach the outside of the roll. However, if such rolls are exposed to very dry air, buckling of the film may be caused by differential shrinkage of the outside edges. On the other hand, exposure to very moist air may produce fluted edges, due to differential swelling and stretching. Neither of these effects occurs to any great extent with ordinary use of the film, but a tight roll of film exposed overnight to very high or very low humidity may be severely damaged.

Although acetate base film usually swells nearly twice as much as nitrate film during processing, it ordinarily shows a slight shrinkage after drying, while nitrate film shows a swell of from 0.05 to 0.1%. Under the usual conditions of storage the shrinkage of nitrate negative film is no more than about 0.4% at the end of two years. Ordinarily, nitrate sound recording film shrinks about a third less than regular nitrate film, while acetate film shrinks about a third more.

The severity of the conditions encountered during handling and projection produces a somewhat more rapid shrinkage in release positives than is found in film stored without use under normal conditions. Ordinarily the shrinkage of release prints measured in theaters will be about 0.3% for nitrate base and 0.6% for acetate base.

CORES AND WINDING

Eastman Motion Picture Films are furnished on several types of cores, depending on the equipment in which they are to be exposed. The standard core types are shown in Figure 10; their uses are noted in the following paragraphs.

No. 10 Spool. A metal camera spool 3⅝ inches in diameter, finished in matte black. It is used with 100-foot lengths of picture negative materials supplied in the special telescoping magazine required by the DeVry and Eyemo cameras.

Type L. An unslotted metal core 72-mm. in diameter. It is inserted in 1000-foot lengths of picture negative materials wound emulsion side out for the DeBrie camera.

Type A. A wooden core 1 inch in diameter. It is used with 200-foot lengths of picture negative materials for the Akeley and certain other cameras and with 200- and 400-foot lengths of positive materials. In either case the film is not wound directly on the core. Instead, the core is inserted in the center of the roll after it is wound. When used with positive materials, this core is not slotted as shown in the illustration.

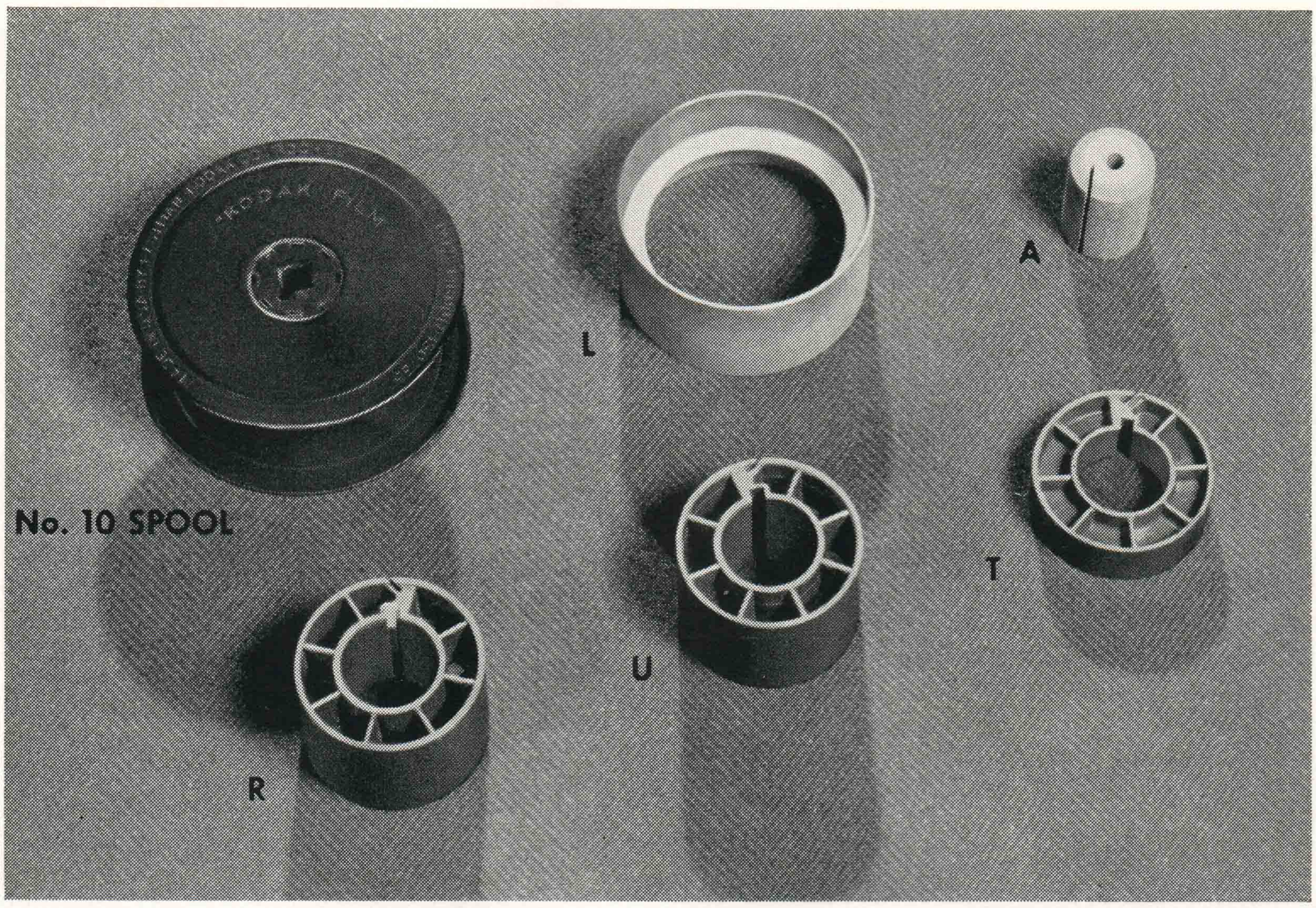


Figure 10. Types of cores used in motion picture work

Type R (Negative). A gray Tenite core 2 inches in diameter and provided with a key extending half way ($^{11}/_{16}$ in.) through the center. This is the standard core for picture negative, sound recording, and bi-pack materials, as well as positive films to be used in title cameras. Films supplied on Type R cores are always wound on.

Dimensions and Tolerances—Kodak Type R Core

Outside Diameter	1.969 ± 0.010 inches
Inside Diameter	1.023 ± 0.004 inches
Width of Key	0.088 ± 0.001 inch
Height of Key	0.088 ± 0.001 inch

Type U (Universal). Similar to the Type R core, but provided with a keyway extending all the way through the center. When used with negative films, it is inserted; positive films are wound on.

Dimensions and Tolerances—Kodak Type U Core

Outside Diameter	1.969 ± 0.010 inches
Inside Diameter	1.023 ± 0.004 inches
Width of Keyway	0.157 ± 0.003 inch
Depth of Keyway	0.157 ± 0.003 inch

Type T (16-mm.). Similar in construction to the Type U core, but 16 instead of 35 mm. in width. It is used with all 16-mm. films except 100- and 200-foot lengths of picture negative materials, which are regularly furnished on daylight loading spools.

Daniel D. Teoli Jr.
Archival Collection

Two different windings are used with 16-mm. films perforated along one edge, as shown in the SMPE Recommended Practice reproduced below. Winding A is regularly used with Sound Recording, Type *5357*, which is specifically designed for making original recordings. Winding B is regularly used with all other types of 16-mm. film perforated along one edge. Any of the 16-mm. films can, however, be obtained with the alternate winding on request.

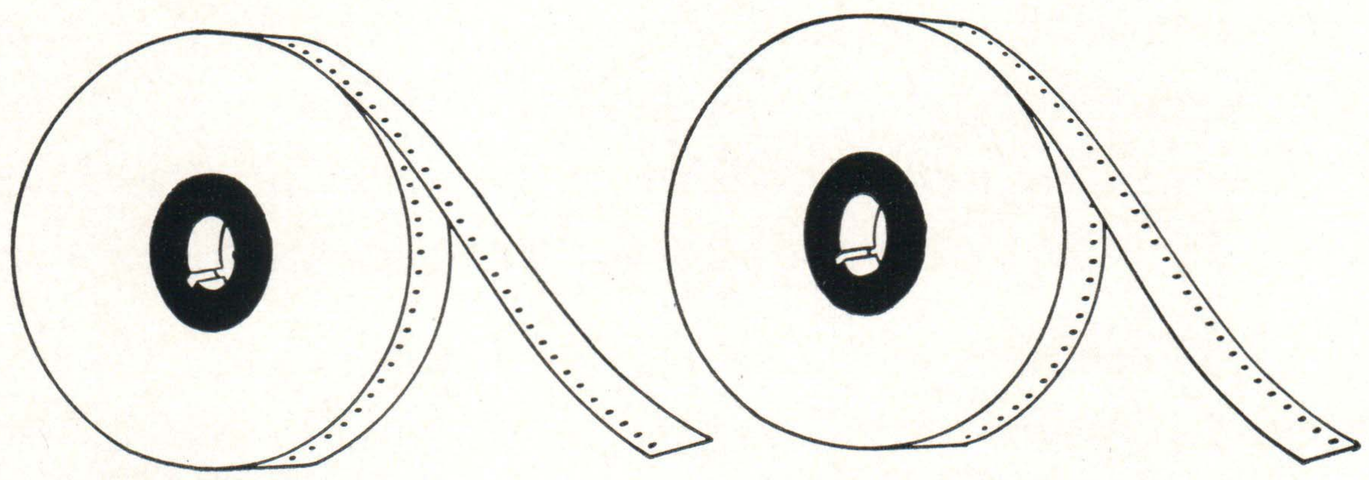
SMPE RECOMMENDED PRACTICE
For 16-mm Motion Picture Film

SMPE-22
1941

DESIGNATION OF DIRECTION OF WINDING OF FILM PERFORATED ALONG ONE EDGE

When a roll of 16-mm. film, perforated along one edge, is held so that the outside end of the film leaves the roll at the top and toward the right, winding *A* shall have the perforations on the edge of the film toward the observer; and winding *B* shall have the perforations on the edge away from the observer. In both cases the emulsion surface shall face inward on the roll.

The following sketch illustrates these definitions:



Winding *A*
Emulsion side in

Winding *B*
Emulsion side in

The above-given sketch shows film wound on cores. When the film is wound on a reel having a square hole on one side and a round hole on the other, the square hole shall be understood to be on the side away from the observer.

Reprinted from *J. Soc. Mot. Pict. Eng.*, **38**, 427 (May, 1942).

Except for 1000-foot lengths of picture negative materials on the Type L core, all Eastman films are furnished wound emulsion in. In the case of bi-pack materials, however, a special situation exists. Here the panchromatic film is wound emulsion in and the orthochromatic film emulsion out, so that the emulsion surfaces are face to face and are exposed through the base of the orthochromatic film as the two films unwind from the feed rolls in the camera.

PACKING

In general, Eastman Motion Picture Films are wound on Type R, U, or T cores, wrapped in black paper envelopes, and packed in metal cans which are taped. The black paper envelopes, which are made from paper especially produced for this purpose in the Kodak Park Paper Mill, not only serve as protection against exposure to light, but also aid in keeping the moisture content of the film uniform. The envelopes are made large enough to provide a tight fit and prevent excessive movement of the roll in the can during shipment. When special lengths of film are packed in standard size cans, a band of brown crepe paper filler is wound around the envelope to produce a tight fit.

The tape used on the outside of film cans serves as a seal between the cover and body of the can and prevents, to a considerable extent, the interchange of moisture between the inside of the can and the external atmosphere. The tape also is produced at Kodak Park for the specific purpose of packing film and is designed to provide resistance to the flow of air. It is used on all cans except the special telescoping magazine for the No. 10 Spool, which is supplied untaped.

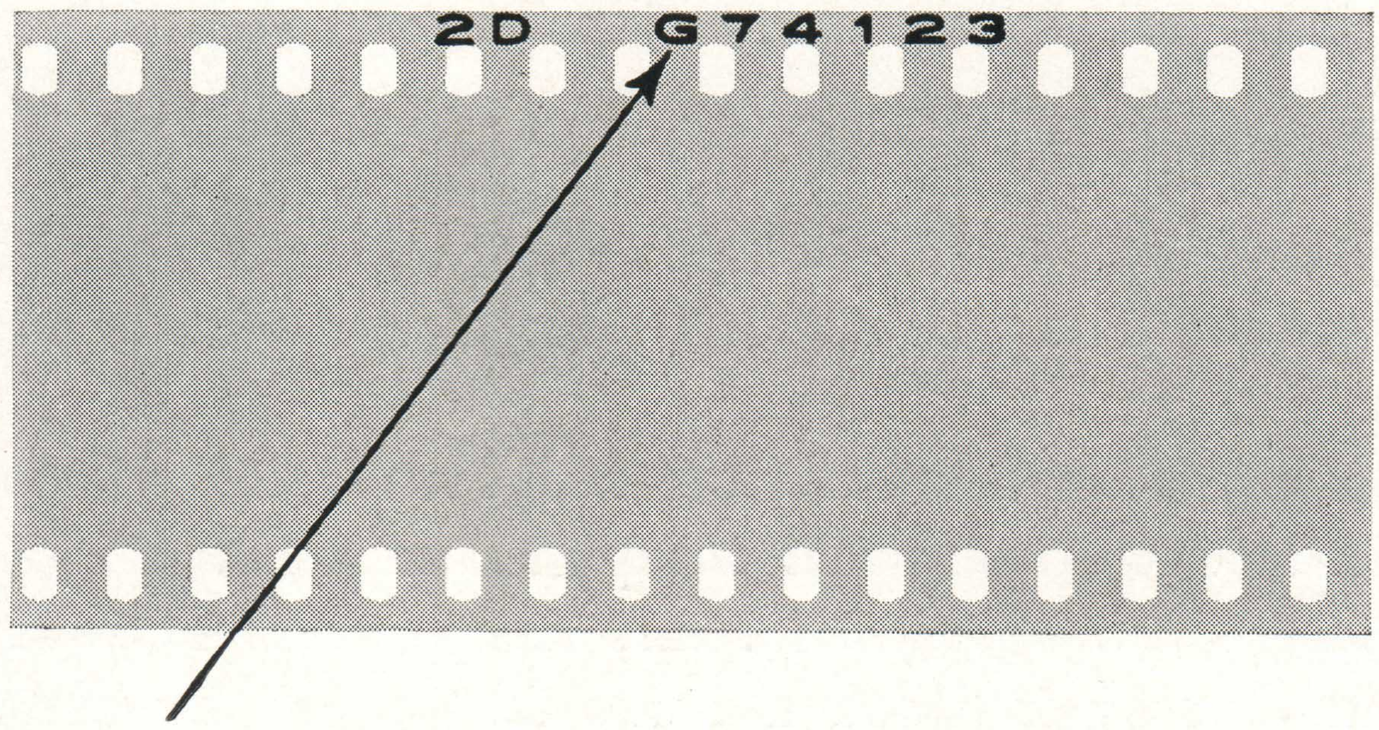
Cans containing nitrate films, except the panchromatic types, are placed directly in wooden boxes for shipment when the quantities involved are large enough to make this method of packing feasible. Panchromatic nitrate films and all safety types are packed in brown corrugated paper cartons.

STORAGE

Particular attention should be paid to the storage and handling of motion picture film on cellulose nitrate support. If proper precautions are not taken, this material is a distinct fire hazard. The regulations of the National Board of Fire Underwriters, recommended by the National Fire Protection Association, should be followed.

Cellulose acetate films are more stable than cellulose nitrate, and will keep for longer periods of time. If acetate film is stored at a fairly low humidity, it tends to become brittle through loss of moisture, but flexibility can be restored by re-humidifying. Eastman Kodak Company acetate films are listed by the Underwriters as: "Film—slow burning. Hazards in the use and storage are small, being somewhat less than would be presented by common newsprint paper in same form and quantity."

TYPE IDENTIFICATION CODE



An initial, like the one indicated above, is printed in ink just ahead of the visible footage numbers on 35-mm. Eastman Motion Picture Films. This system of identification affords a sure means of determining—either before development or afterward—the type of Eastman Film being handled. The type shown in the illustration is Plus-X Panchromatic Negative, Type *1231* (see legend on opposite page). Release positive and 16-mm. materials can be obtained footage numbered on request, but do not bear an identifying letter.

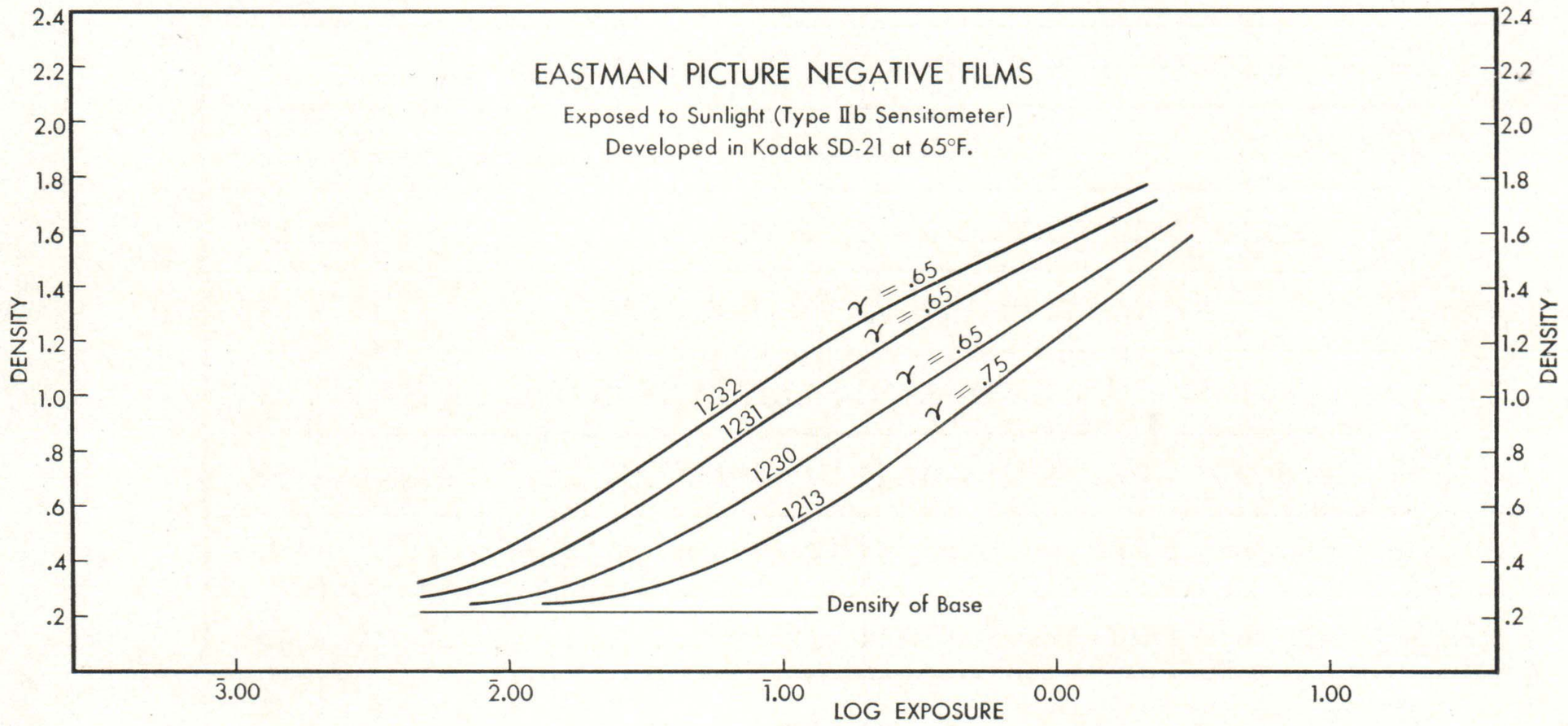
Frame-line markings are printed in ink along one edge of all 35-mm. Eastman Motion Picture Films with the exception of the picture negative and bi-pack materials.

SPECIFICATION SHEETS

Code Initial	Type Number	Film (*Available in 16-mm. Safety)	Page
E	1210	INFRARED NEGATIVE	41
B	1213	BACKGROUND PANCHROMATIC NEGATIVE	42
B	1230	BACKGROUND-X PANCHROMATIC NEGATIVE	43
G	1231	PLUS-X PANCHROMATIC NEGATIVE	44
H	1232	SUPER-XX PANCHROMATIC NEGATIVE	45
	5240	PANCHROMATIC NEGATIVE *16-mm. Safety*	46
	5242	SUPER-XX PANCHROMATIC NEGATIVE *16-mm. Safety*	47
A	1234	BI-PACK ORTHOCHROMATIC *Exterior*	49
	1235	BI-PACK PANCHROMATIC *Exterior and Interior*	50
C	1236	BI-PACK ORTHOCHROMATIC *Interior*	51
	1301	RELEASE POSITIVE*	53
	1302	FINE GRAIN RELEASE POSITIVE*	54
	1363	HIGH CONTRAST POSITIVE*	56
	1509	DUPLITIZED POSITIVE	57
D	1203	FINE GRAIN PANCHROMATIC DUPLICATING NEGATIVE*	59
D	1505	DUPLICATING NEGATIVE	60
D	1355	DUPLICATING POSITIVE	61
D	1362	HIGH CONTRAST DUPLICATING POSITIVE*	62
D	1365	FINE GRAIN DUPLICATING POSITIVE*	63
S	1357	SOUND RECORDING*	66
S	1370	FINE GRAIN SOUND RECORDING	67
	1301	RELEASE POSITIVE *for Sound Recording**	68
	1302	FINE GRAIN RELEASE POSITIVE *for Sound Recording**	69
		LEADER STOCK *Nitrate and Safety*	70

EASTMAN PICTURE NEGATIVE FILMS

ALL EASTMAN picture negative materials are coated on base containing gray dye to prevent halation. With the exception of Infrared, Type *1210*, a special purpose film intended for use in making night-effect scenes in sunlight, they all have panchromatic sensitivity.



The panchromatic films form a series designed to fill every need that may arise in exterior or interior photography. Their balanced color sensitivity enables them to produce good tonal gradation throughout the full range of colors.

ROLLS AVAILABLE, 35-MM. PICTURE NEGATIVE FILMS

Length in Feet	*Type of Core*	*Camera*	*Winding*
100	No. 10 Spool	DeVry, Eyemo	Wound on
200	R (2-in. with key)	Eyemo (200-ft. mag.)	Wound on
200	U (2-in. with keyway)	DeBrie	Inserted
200	A (1-in. wooden)	Akeley	Inserted
400	R (2-in. with key)	B & H, Mitchell	Wound on
400	U (2-in. with keyway)	DeBrie	Wound on
1000	R (2-in. with key)	Akeley, B & H, Mitchell	Wound on
1000	L (72-mm. Metal)	DeBrie	Inserted

Picture negative films are regularly furnished with visible footage numbers and Standard Negative (Bell & Howell) perforations, but are not frame-line marked.

Specifications — EASTMAN INFRARED NEGATIVE FILM, Type 1210

General Properties: Sensitive to infrared radiation as well as to the blue light of the visible spectrum, this film can be used for making night-effect scenes in sunlight. With a filter such as the Wratten A or F to absorb blue light, it produces a realistic illusion of night, the blue sky photographing very dark. *1210* is also exposed with filters ranging from the Wratten No. 15 (G) to No. 89 to produce striking and unusual effects in daylight scenes. The infrared sensitivity allows the reproduction of detail ordinarily obscured by atmospheric haze.

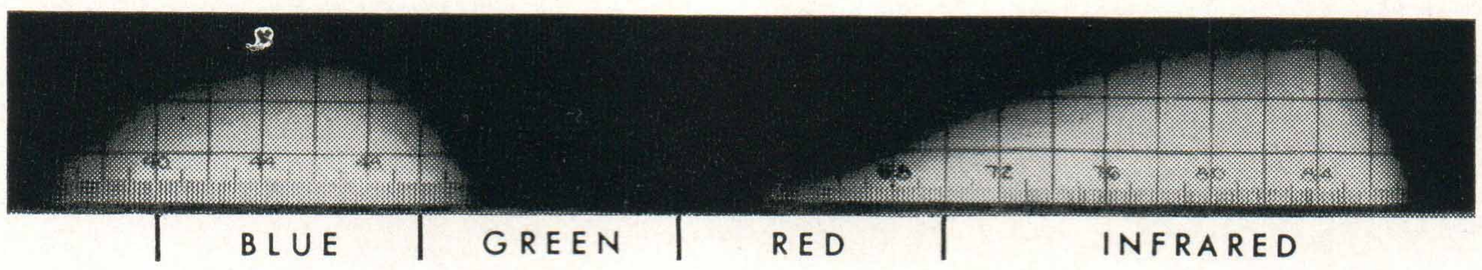
Speed and Recommended Exposure Meter Settings: For exposure through the Wratten A or F Filter, and for development in Kodak SD-21 to a gamma of 0.65.

Kodak Film Speed	Meter Settings	Weston	G. E.
Tungsten 4 (Sunlight 1.2)	Tungsten	1	1.5

No meter settings are given for daylight since the ratio of infrared to visible radiation in daylight varies considerably, and meters respond principally to visible light, but this ratio for tungsten light is sufficiently constant to warrant use of a meter.

This film is usually used on location and for night effects is normally exposed at *f*/4 to *f*/5.6 in bright sunlight, using the Wratten A or F. Test strips should be developed to insure that the exposure is correct to give the desired effect.

Color Sensitivity: Blue and infrared.



Filters: To obtain infrared effects, a filter must be used. The Wratten G (No. 15), A (No. 25), F (No. 29), and No. 70 are recommended. The Wratten No. 87 or No. 89 can also be used, but require twice the exposure of the others.

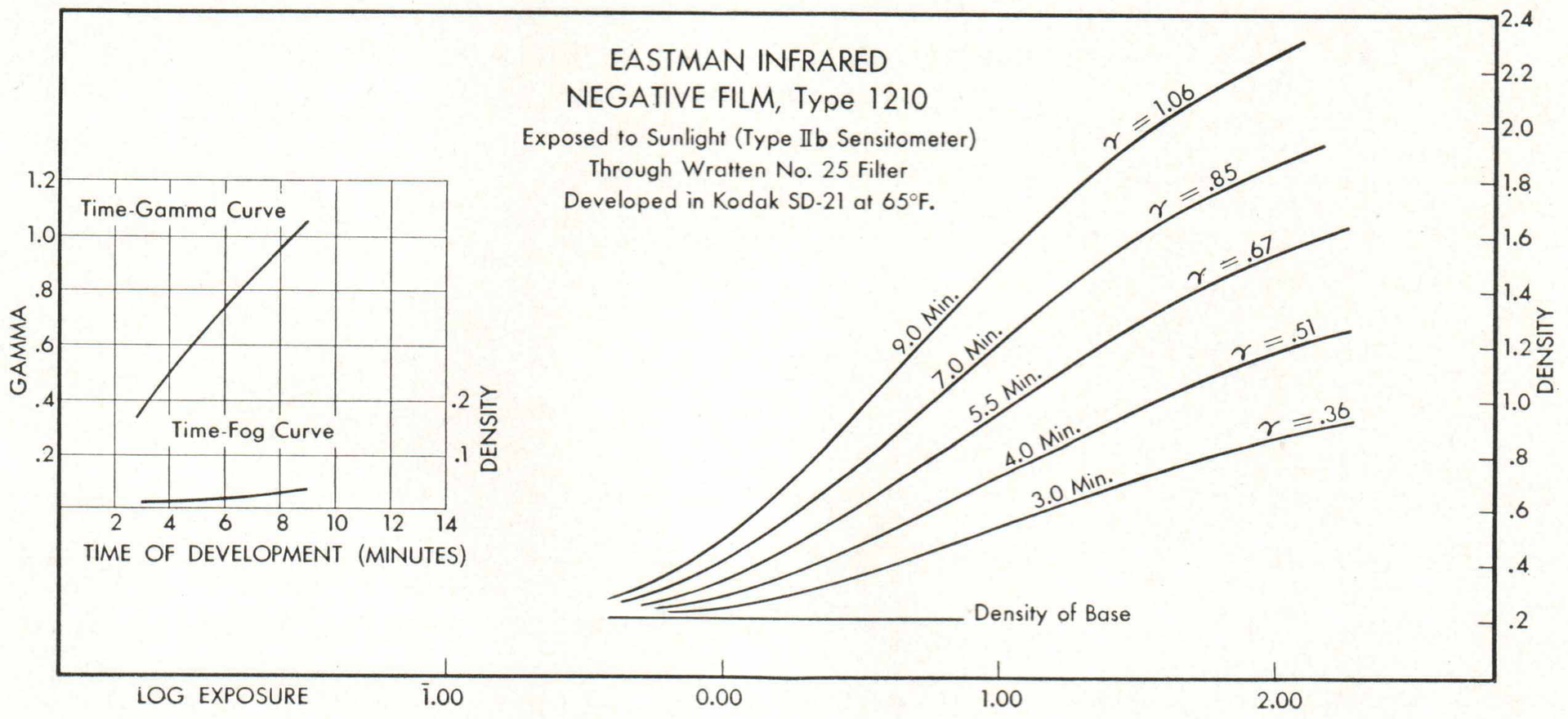
Recommended IIb Control Gamma: 0.60 to 0.70. For special effects, higher or lower contrast may be desirable.

Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 7 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of a few seconds at 3 feet.

Base: Gray nitrate. **Rolls Available:** 35-mm. x 100, 200, 400, or 1000 feet.

Perforations: Standard 35-mm. Negative. **Cores and Winding:** See p. 40.

Identification: The letter E is printed just before the footage number.



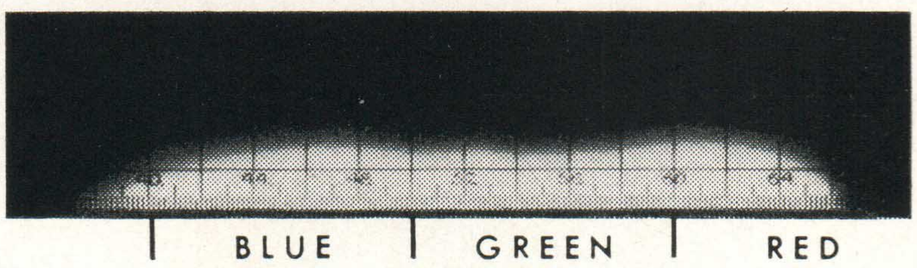
Specifications—EASTMAN BACKGROUND PANCHROMATIC NEGATIVE FILM, Type 1213

General Properties: A low speed negative material of extremely fine grain. Intended primarily for use in making original negatives from which prints are to be made for background projection, it is also suitable for general exterior photography and for special purposes, such as making title negatives or duplicate negatives, when additional sensitivity for copying or printing is necessary. This film, the slowest of the Eastman panchromatic picture negative materials, is the finest in grain.

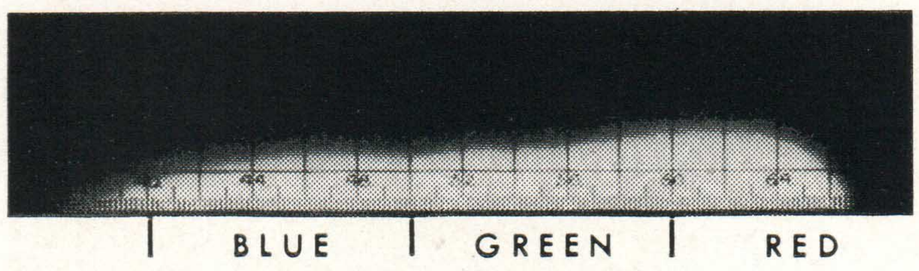
Speed and Recommended Exposure Meter Settings: For development in Kodak SD-21 to a gamma of 0.75.

Kodak Film Speed	Meter Settings	Weston	G. E.
Sunlight 40 Tungsten 24	Sunlight Tungsten	10 6	16 10

Color Sensitivity: Panchromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

Filter Factors: See Filter Exposure Table, page 15.

Recommended IIb Control Gamma: 0.60 to 0.80, depending on the purpose for which the film is used.

Resolving Power: 60 lines per mm. in Kodak SD-21.

Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 3 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of a few seconds at 3 feet.

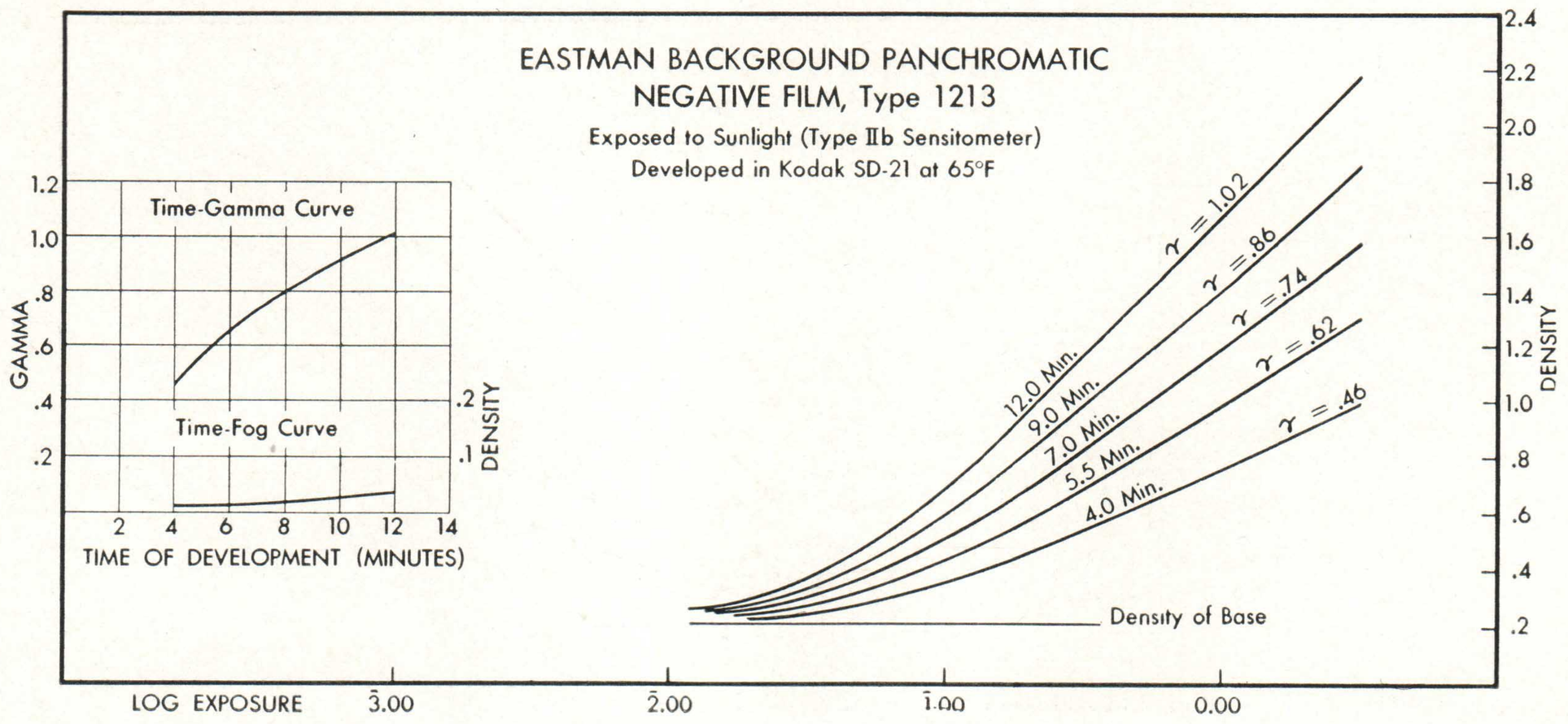
Base: Gray nitrate.

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 100, 200, 400, or 1000 feet.

Cores and Winding: See page 40.

Identification: The letter B is printed just before the footage number.



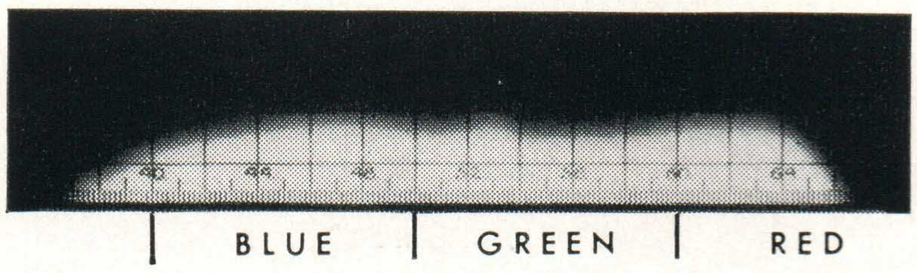
Specifications—EASTMAN BACKGROUND-X PANCHROMATIC NEGATIVE FILM, Type 1230

General Properties: A very fine-grain, medium speed negative material, particularly suitable for general exterior photography. Although its speed is more than twice that of Background, Type *1213*, its graininess is only very slightly greater. *1230* can be utilized for the same purposes as *1213* whenever additional speed and slightly lower contrast characteristics are desired. Background-X for exterior scenes and Plus-X for interior scenes form an ideal combination for production work, since their development rates are similar, and their speed relationship is such that apertures of the same order can be employed for both exteriors and interiors.

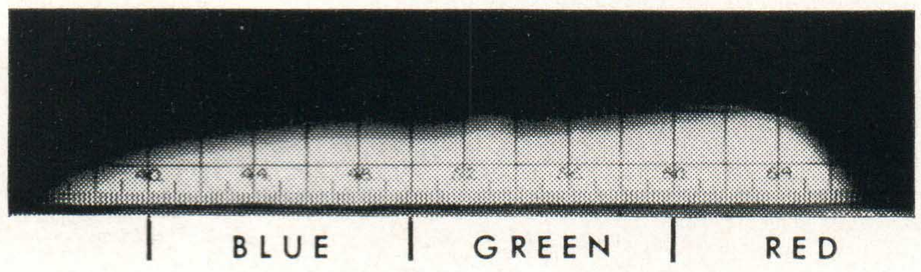
Speed and Recommended Exposure Meter Settings: For development in Kodak SD-21 to gamma of 0.65.

Kodak Film Speed	Meter Settings	Weston	G. E.
Sunlight 100 Tungsten 64	Sunlight Tungsten	24 16	40 24

Color Sensitivity: Panchromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

Filter Factors: See Filter Exposure Table, page 15.

Recommended IIb Control Gamma: 0.60 to 0.70. When prints are to be made for background projection, a higher gamma (0.70 to 0.80) is desirable.

Resolving Power: 60 lines per mm. in Kodak SD-21.

Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 3 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of a few seconds at 3 feet.

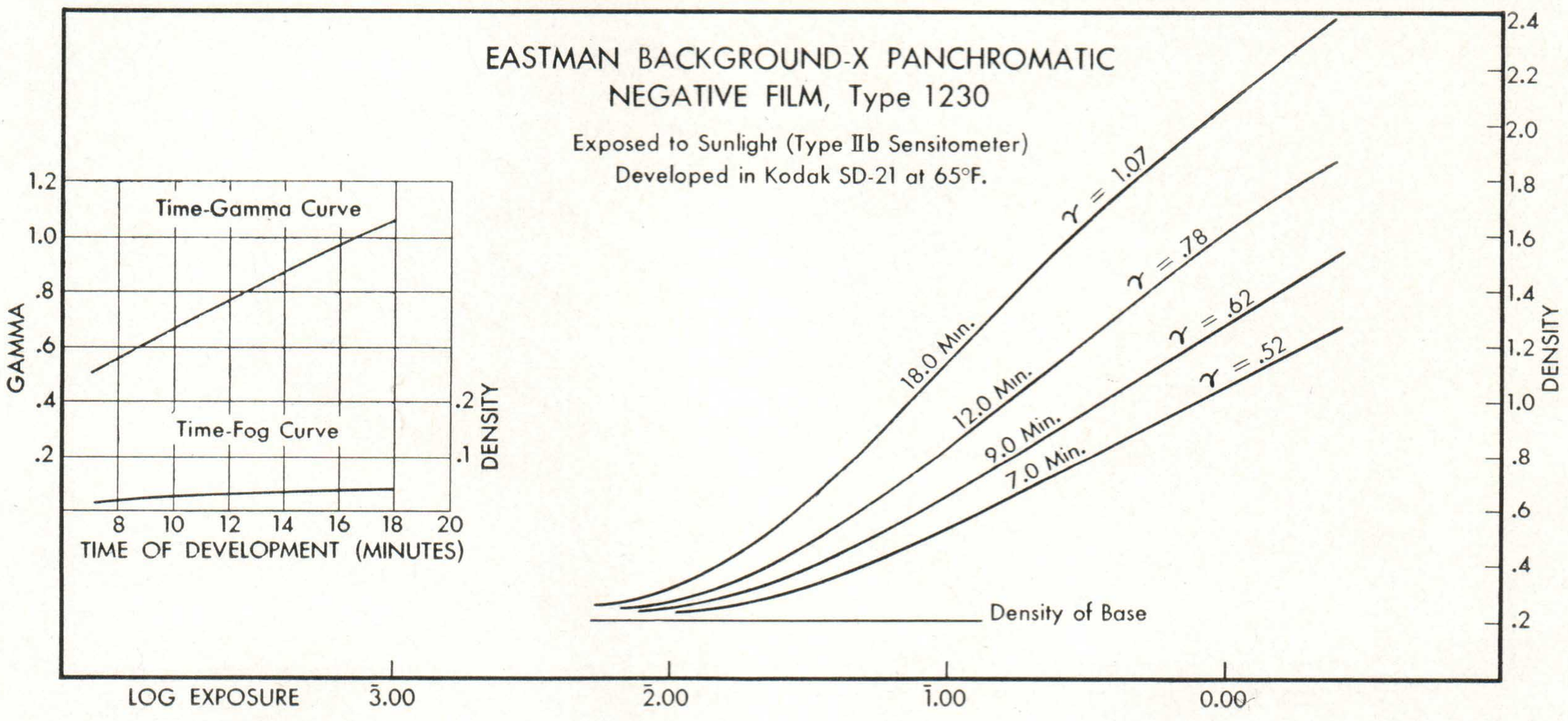
Base: Gray nitrate.

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 100, 200, 400, or 1000 feet.

Cores and Winding: See page 40.

Identification: The letter B is printed just before the footage number.



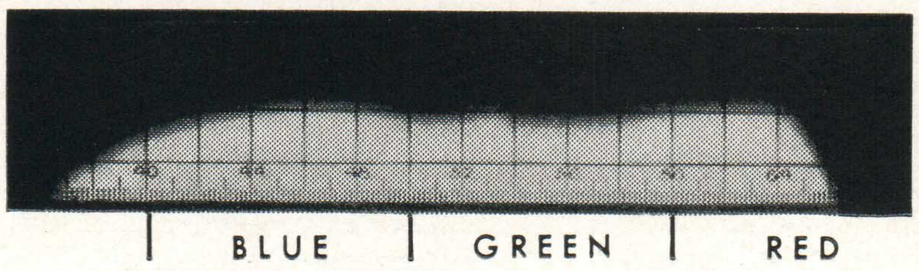
Specifications—EASTMAN PLUS-X PANCHROMATIC NEGATIVE FILM, Type 1231

General Properties: A high speed, fine-grain negative material, well suited to general interior photography and to exterior photography under poor lighting conditions. This film represents an excellent balance between the maximum desirable speed for most purposes and the finest grain obtainable at that speed. It is widely used for general production work and is also suitable for making composite projection background scenes, since its speed is sufficient to permit the use of small apertures in order to secure good depth of field.

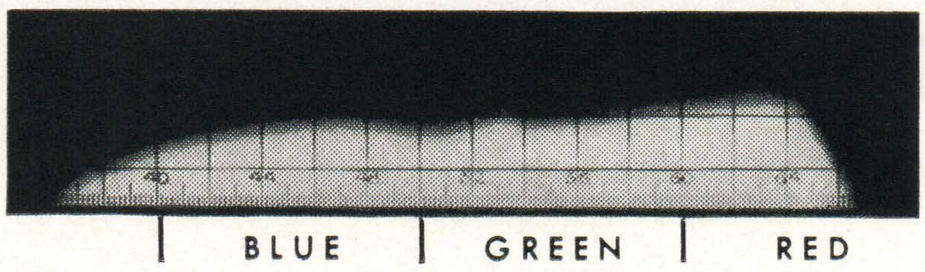
Speed and Recommended Exposure Meter Settings: For development in Kodak SD-21 to a gamma of 0.65.

Kodak Film Speed	Meter Settings	Weston	G. E.
Sunlight 240 Tungsten 160	Sunlight Tungsten	64 40	100 64

Color Sensitivity: Panchromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

Filter Factors: See Filter Exposure Table, page 15.

Recommended IIb Control Gamma: 0.60 to 0.70.

Resolving Power: 55 lines per mm. in Kodak SD-21.

Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 3 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of a few seconds at 3 feet.

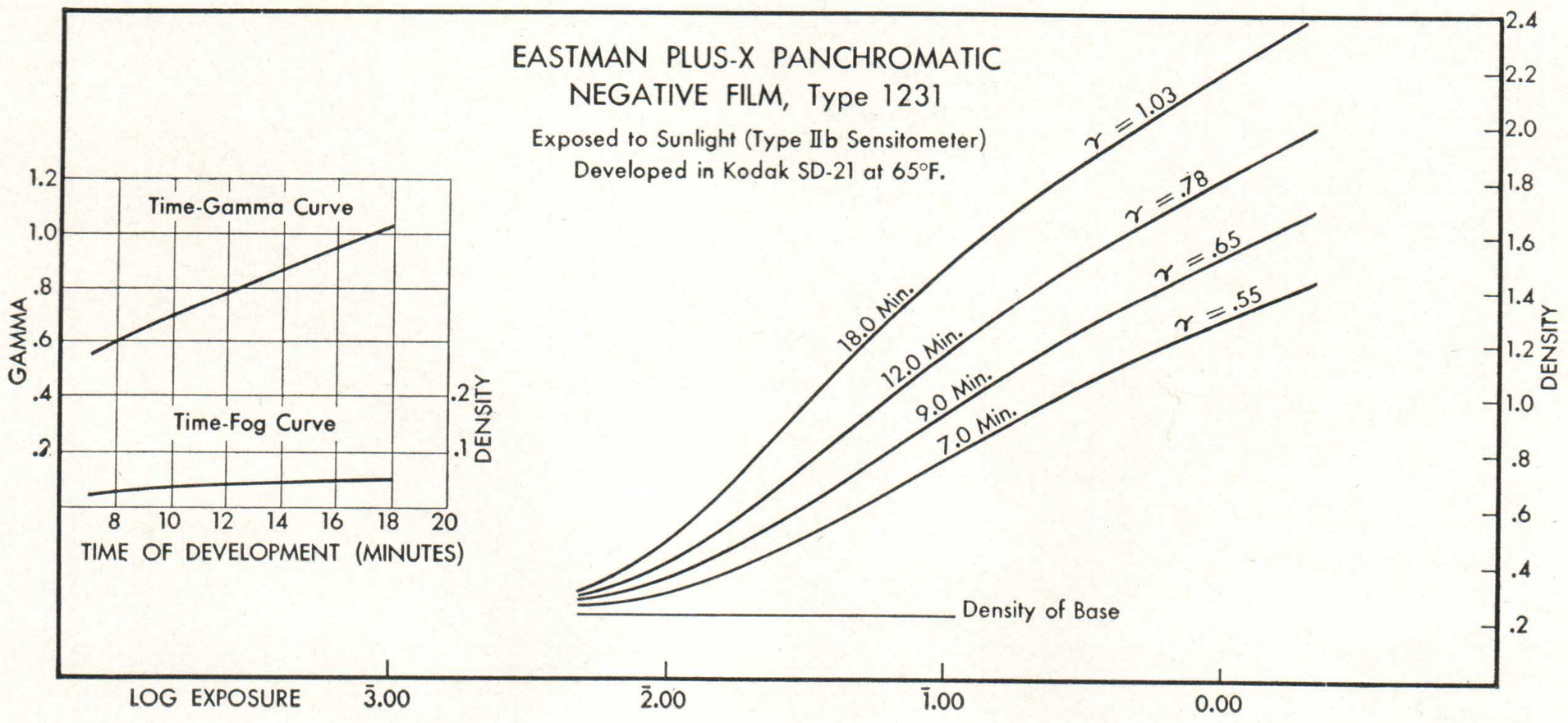
Base: Gray nitrate.

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 100, 200, 400, or 1000 feet.

Cores and Winding: See page 40.

Identification: The letter G is printed just before the footage number.



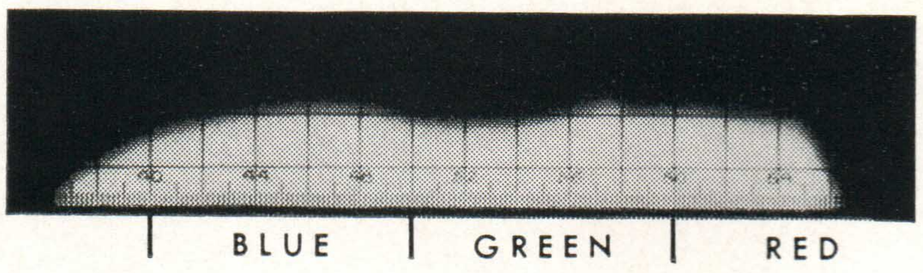
Specifications — EASTMAN SUPER-XX PANCHROMATIC NEGATIVE FILM, Type 1232

General Properties: A very high speed negative material of medium graininess. This film is designed to provide the maximum emulsion speed consistent with excellent photographic quality. It is particularly suited to newsreel work, where photographs of important news events often must be obtained under extremely poor lighting conditions, but can also be used in production work whenever the need for maximum emulsion speed arises. For example, it is useful for exterior or interior photography under adverse light conditions and, in studio interiors, for obtaining great depth of field without an undue increase in the level of illumination.

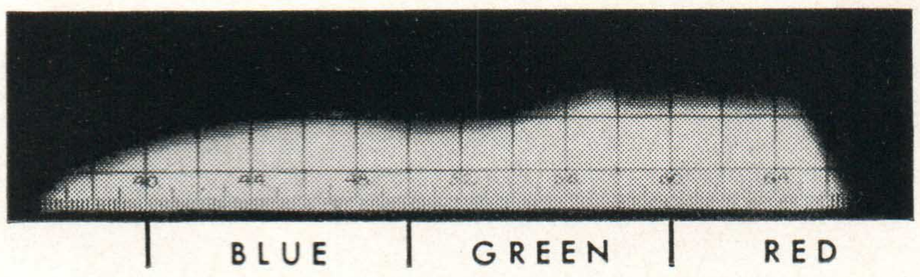
Speed and Recommended Exposure Meter Settings: For development in Kodak SD-21 to a gamma of 0.65.

Kodak Film Speed	Meter Settings	Weston	G. E.
Sunlight 400 Tungsten 250	Sunlight Tungsten	100 64	160 100

Color Sensitivity: Panchromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

Filter Factors: See Filter Exposure Table, page 15.

Recommended IIb Control Gamma: 0.60 to 0.70.

Resolving Power: 55 lines per mm. in Kodak SD-21.

Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 3 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of a few seconds at 3 feet.

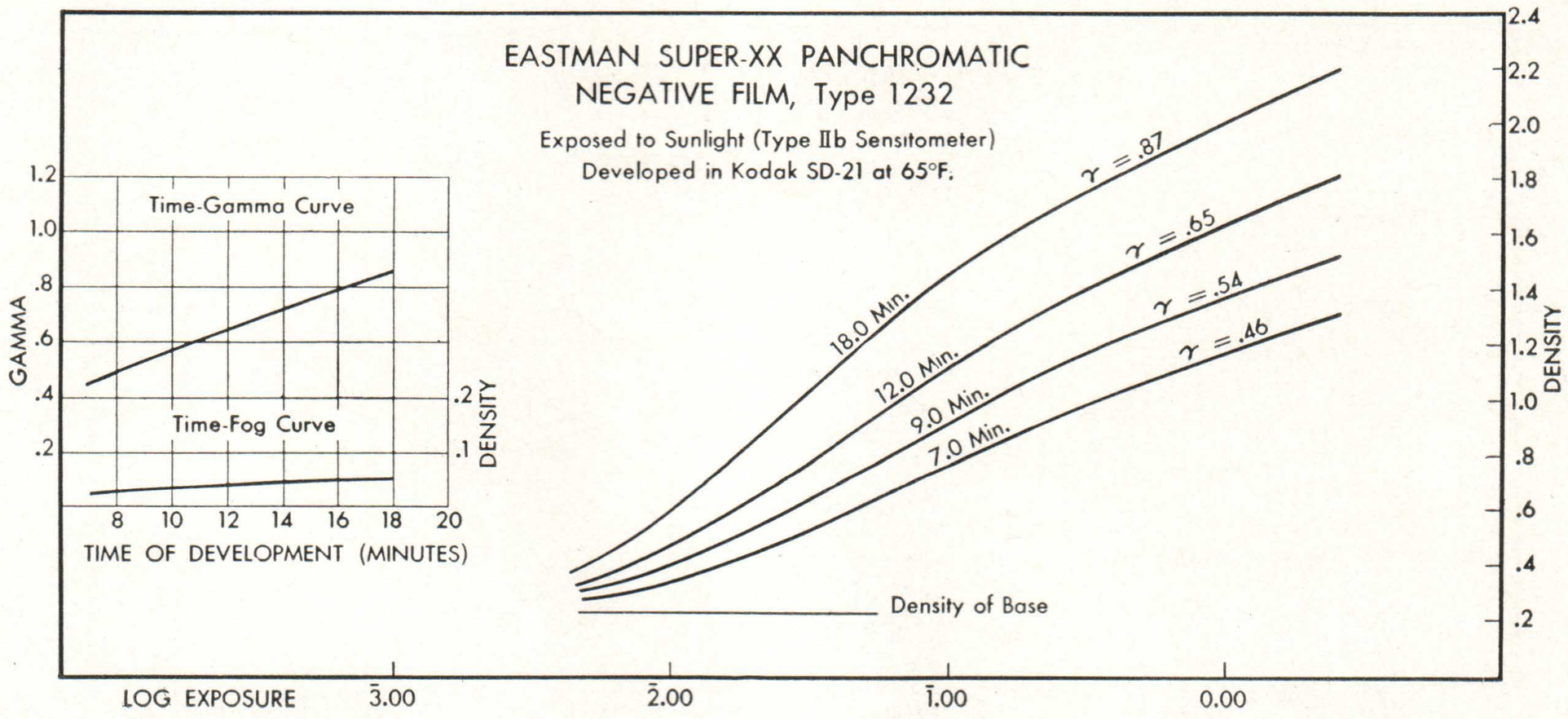
Base: Gray nitrate.

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 100, 200, 400, or 1000 feet.

Cores and Winding: See page 40.

Identification: The letter H is printed just before the footage number.



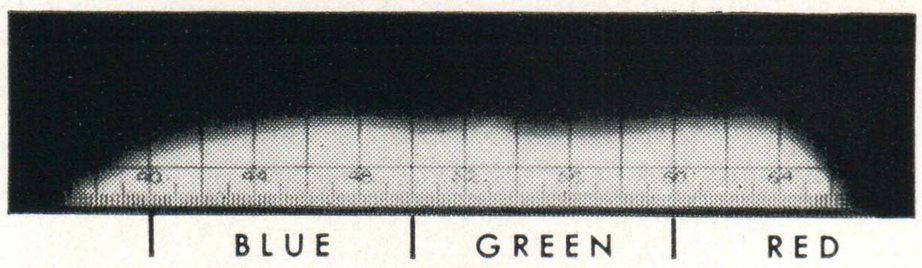
Specifications—EASTMAN PANCHROMATIC NEGATIVE SAFETY FILM, Type 5240 (16-mm.)

General Properties: A fine-grain, medium-speed negative material suitable for general use in exterior and interior photography. It is similar to Background-X Panchromatic, Type *1230*.

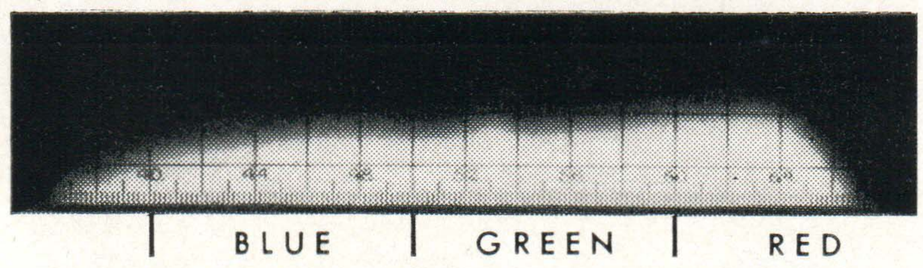
Speed and Recommended Exposure Meter Settings: For development in Kodak SD-21 to a gamma of 0.65.

Kodak Film Speed	Meter Settings	Weston	G. E.
Sunlight 100 Tungsten 64	Sunlight Tungsten	24 16	40 24

Color Sensitivity: Panchromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

Filter Factors: See Filter Exposure Table, page 15.

Recommended IIb Control Gamma: 0.60 to 0.70.

Resolving Power: 60 lines per mm. in Kodak SD-21.

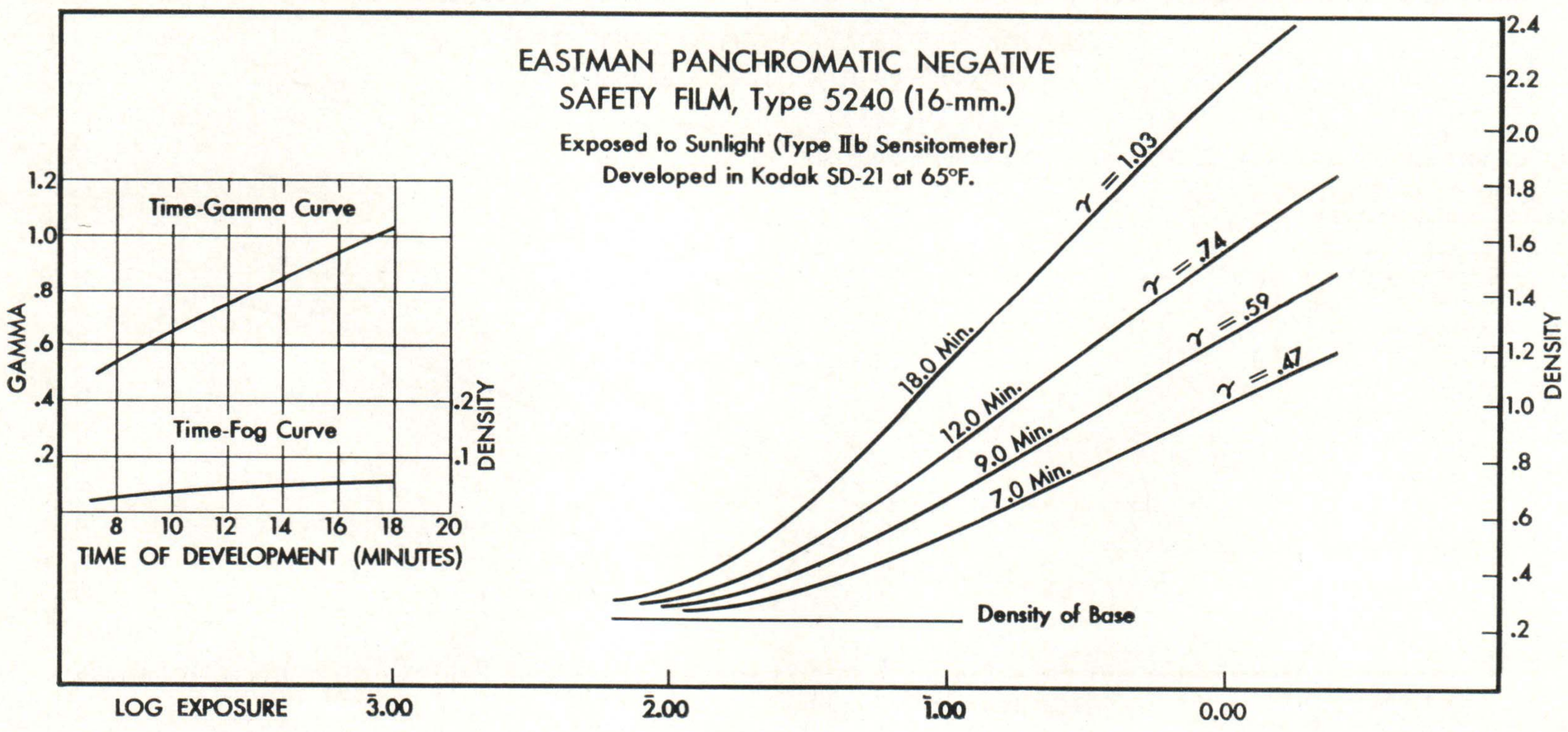
Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 3 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of a few seconds at 3 feet.

Base: Blue-gray acetate.

Perforations: Standard 16-mm. Silent or Sound (perforated one side).

Rolls Available: 16-mm. x 100 or 200 feet (daylight loading); 16-mm. x 400 feet (darkroom loading). The 200-foot length can also be supplied on request wound on plain cores without leaders or trailers, for darkroom loading.

Cores and Winding: Type T, wound on (for darkroom loading). Winding B is used with *5240* perforated one side.



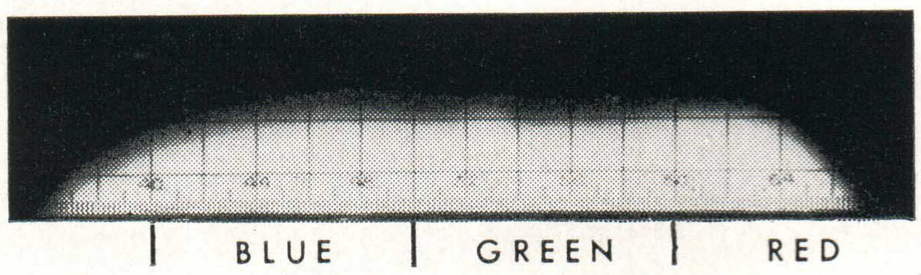
Specifications—EASTMAN SUPER-XX PANCHROMATIC NEGATIVE SAFETY FILM, Type 5242 (16-mm.)

General Properties: A very high speed negative material of moderate graininess, especially valuable for use under adverse lighting conditions. It is similar to Super-XX Panchromatic, Type *1232*.

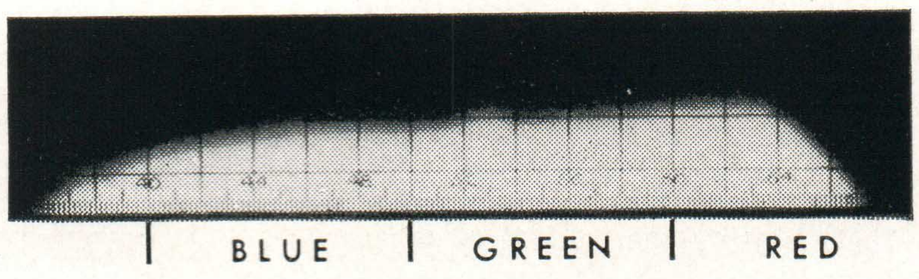
Speed and Recommended Exposure Meter Settings: For development in SD-21 to a gamma of 0.65.

Kodak Film Speed	Meter Settings	Weston	G. E.
Sunlight 400 Tungsten 250	Sunlight Tungsten	100 64	160 100

Color Sensitivity: Panchromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

Filter Factors: See Filter Exposure Table, page 15.

Recommended IIb Control Gamma: 0.60 to 0.70.

Resolving Power: 55 lines per mm. in Kodak SD-21.

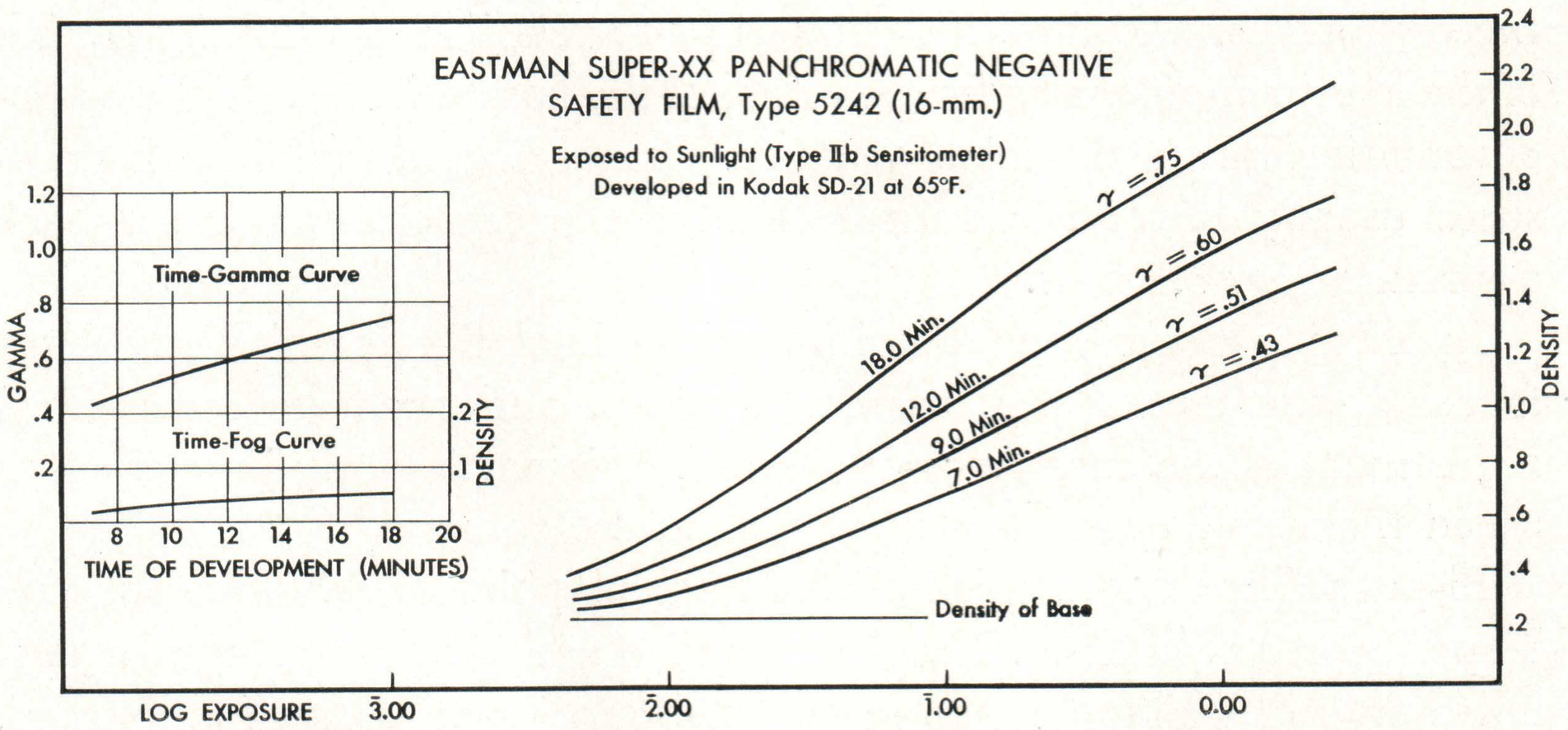
Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 3 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of a few seconds at 3 feet.

Base: Blue-gray acetate.

Perforations: Standard 16-mm. Silent.

Rolls Available: 16-mm. x 100 or 200 feet (daylight loading); 16-mm. x 400 feet (darkroom loading). The 200-foot length can also be supplied on request wound on plain cores without leaders or trailers for darkroom loading.

Cores and Winding: Type T, wound on (for darkroom loading).



EASTMAN BI-PACK FILMS

THE BI-PACK films, intended for use in two-color photography, consist of an orthochromatic film and a panchromatic film which are threaded together in the camera and exposed simultaneously. The front element (orthochromatic) records the blue and green light reflected from the subject, while the back element (panchromatic) records the yellow, orange, and red light reflected from the subject. Release prints in color are obtained by dye toning prints made from the negatives on Duplitized Positive, Type *1509*.

Two orthochromatic films are supplied, an exterior type for use under daylight illumination and an interior type for use under tungsten illumination. Because the exposure is made through the base of the front element, both the exterior and interior orthochromatic films are coated on gray base of somewhat lower density than that used for the regular panchromatic negative films. This gives protection against halation with a minimum increase in exposure. The panchromatic element of the bi-pack combination is the same for either exterior or interior work; it is coated on base similar in all respects to that used for the orthochromatic elements.

The orthochromatic films are overcoated with a thin orange-red filter layer. The smooth, glossy finish of this layer insures good contact with the surface of the panchromatic film, while the dye absorption prevents blue or green light from reaching the back element.

Since the two emulsions in contact are exposed through the base of the orthochromatic film, it is necessary to readjust the infinity setting of the lens to compensate for the effect of the base thickness of the orthochromatic film on the focal distance. Cameras used for bi-pack exposures usually have the ground glass of the camera finder set back approximately 3.5 mils.

In order to insure good definition on the back film, consistently sharp focusing, the use of well corrected lenses, and accurate mechanical adjustment of the camera are required. It is particularly important to avoid the use of worn registering pins in the camera.

Bi-pack films are furnished in matched pairs of 400-foot rolls on Type R cores, wound on. They are supplied with Standard Negative perforations and visible footage numbers, but are not frame-line marked.

Specifications—EASTMAN BI-PACK ORTHOCHROMATIC NEGATIVE FILM, Type 1234, Front Exterior

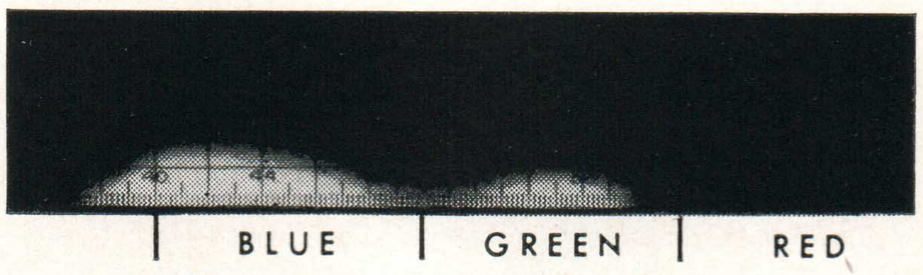
General Properties: A red dye overcoated orthochromatic negative material of medium speed. Its color sensitivity and contrast are balanced to daylight illumination. This is the front film used in combination with Bi-Pack Panchromatic, Type *1235*, to make separation negatives of exterior scenes for two-color printing processes.

For photography under white flame arc illumination, the exterior type bi-pack should be used, and the arcs should be screened with straw-colored gelatin filters (such as the Y1 Brigham) to correct the spectral quality of the illumination to the color balance of the film combination.

Speed and Recommended Exposure Meter Settings: For Exterior Bi-Pack Pair, developed in Kodak SD-21 to a gamma of 0.65.

Kodak Film Speed	Meter Settings	Weston	G. E.
Sunlight 24	Sunlight	6	10

Color Sensitivity: Orthochromatic.



Spectrogram to Sunlight

Recommended IIb Control Gamma: 0.60 to 0.70. The contrast required depends to some extent on the particular color process employed.

Resolving Power: 110 lines per mm. in Kodak SD-21.

Safelight: Wratten Series 2 (deep red).

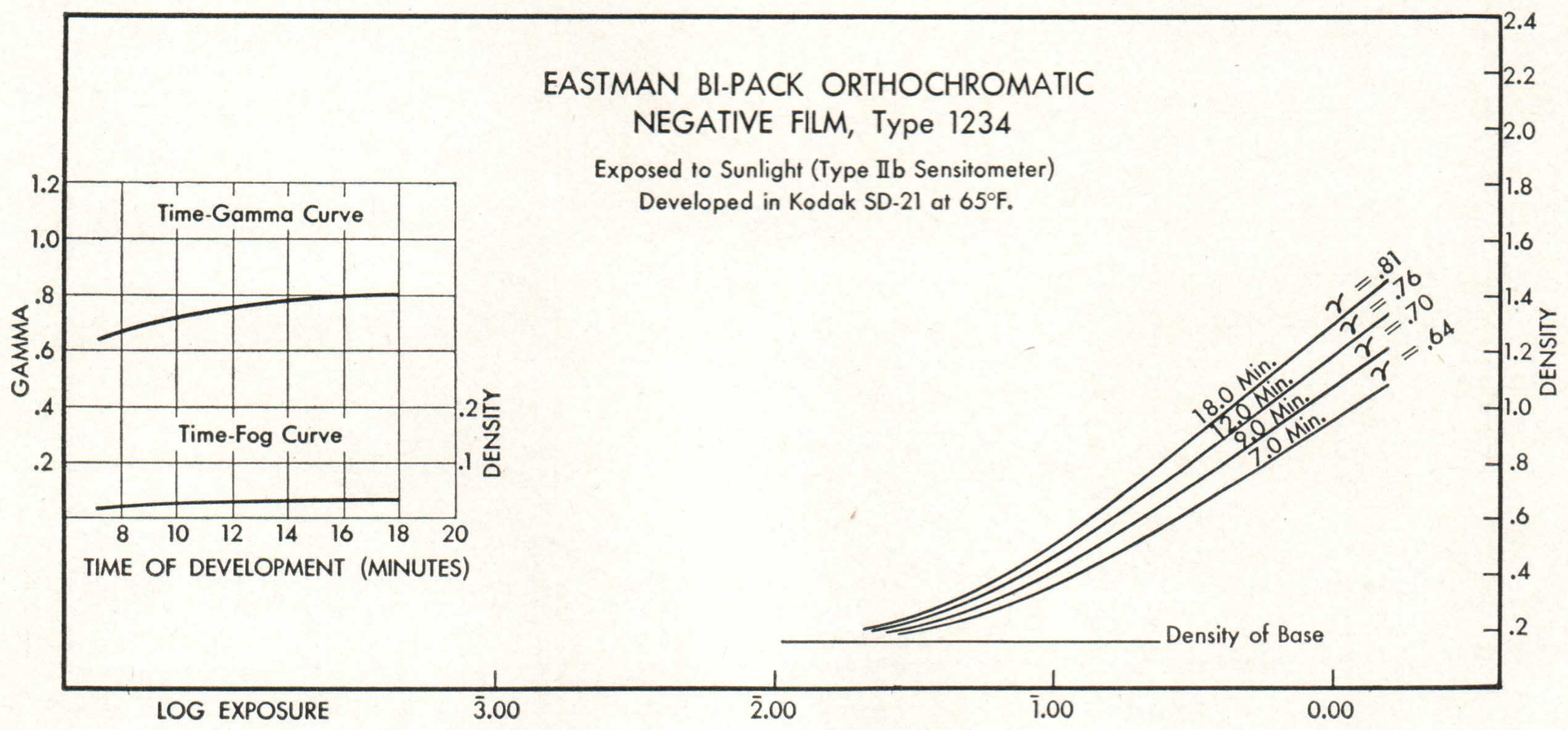
Base: Gray nitrate (approximately two-thirds normal density).

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 400 feet (footage numbered but not frame-line marked). This film is supplied in matched rolls with Bi-Pack Panchromatic, Type *1235*.

Cores and Winding: Type R, wound on (emulsion out).

Identification: The letter A is printed just before the footage number.

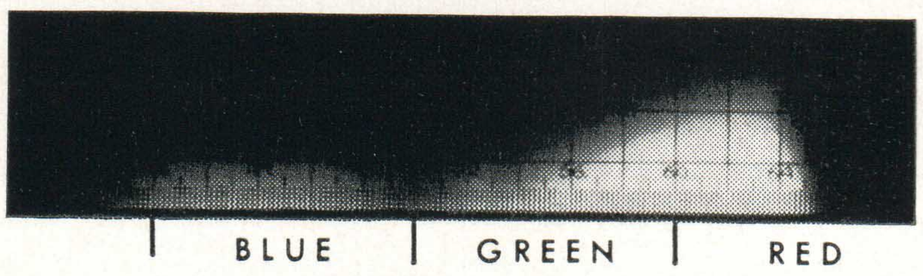


Specifications—EASTMAN BI-PACK PANCHROMATIC NEGATIVE FILM, Type 1235, Back Exterior and Interior

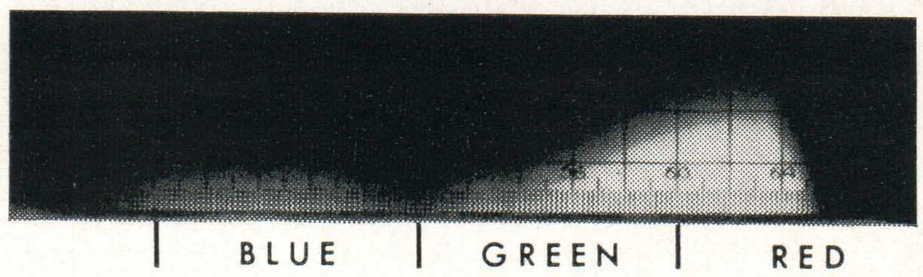
General Properties: A panchromatic negative material balanced in speed and color sensitivity for bi-pack work. This is the back film used in combination with Bi-Pack Orthochromatic, Type *1234* (Front Exterior), or Type *1236* (Front Interior) to make separation negatives for two-color printing processes.

Speed and Recommended Exposure Meter Settings: See pages 49 and 51.

Color Sensitivity: Panchromatic.



Spectrogram to Sunlight
Exposed through Type *1234*



Spectrogram to Tungsten Light
Exposed through Type *1236*

Recommended IIb Control Gamma: Same as for orthochromatic element of bi-pack, 0.60 to 0.70.

Resolving Power: 55 lines per mm. in Kodak SD-21 (for direct exposure, not through orthochromatic element).

Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 3 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of a few seconds at 3 feet.

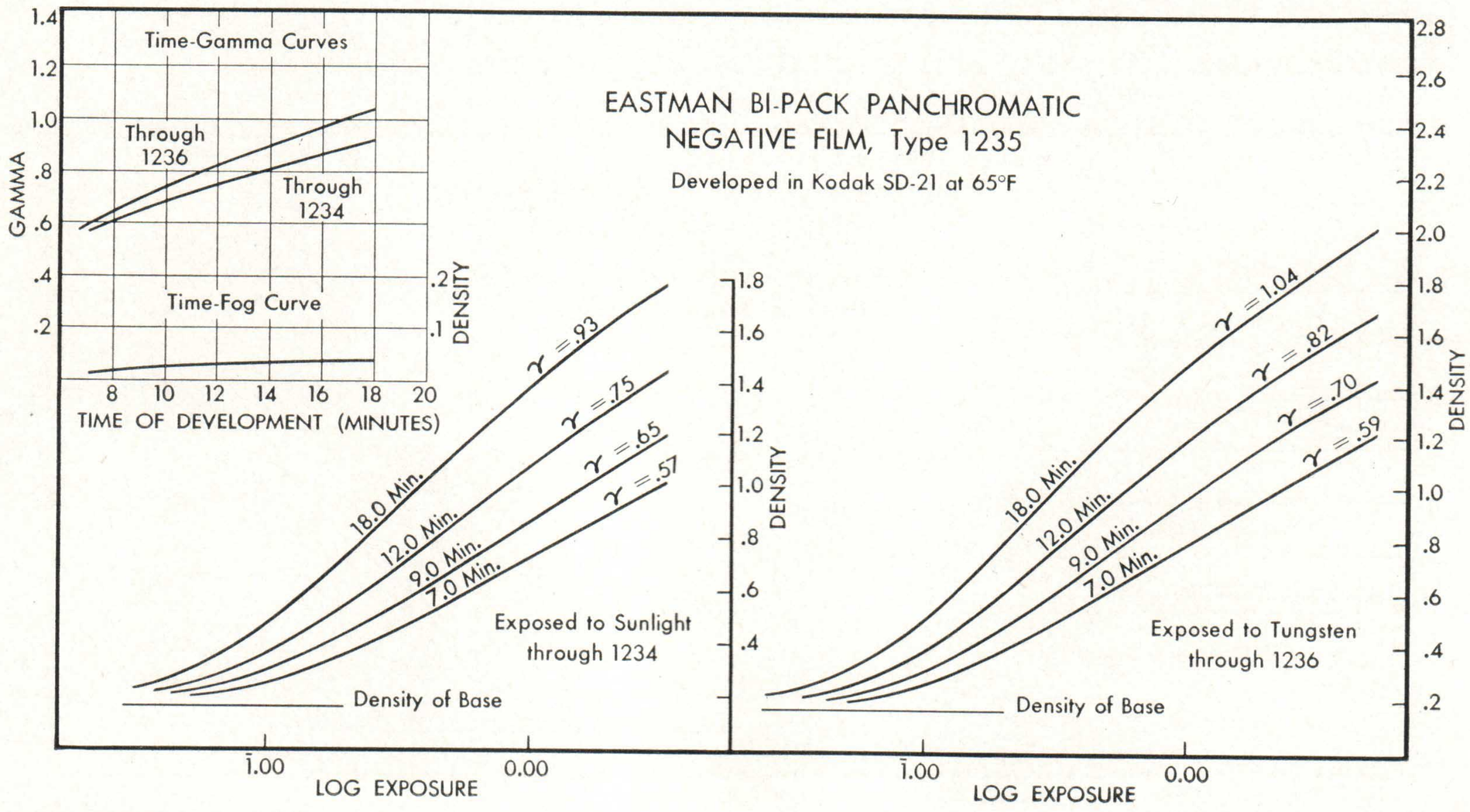
Base: Gray nitrate (approximately two-thirds normal density).

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 400 feet (footage numbered but not frame-line marked). This film is supplied in matched rolls with Bi-Pack Orthochromatic, Type *1234* (Exterior) or Type *1236* (Interior).

Cores and Winding: Type R, wound on (emulsion in).

Identification: This film does not bear an identifying letter.



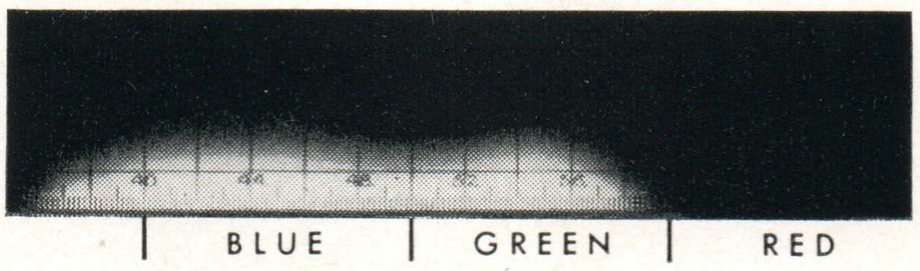
Specifications—EASTMAN BI-PACK ORTHOCHROMATIC NEGATIVE FILM, Type 1236, Front Interior

General Properties: A red dye overcoated orthochromatic negative material of medium speed. Its color sensitivity and contrast are balanced for tungsten illumination at 3200-3400° Kelvin. This is the front film used in combination with Bi-Pack Panchromatic, Type *1235*, to make separation negatives of interior scenes for two-color printing processes. When arcs must be used with tungsten illumination because of their directional properties, the *exterior* type bi-pack should be used with straw-colored filters on the arcs and Macbeth Whiterlite Filters on the tungsten lamps. See page 49.

Speed and Recommended Exposure Meter Settings: For Interior Bi-Pack Pair, developed in Kodak SD-21 to a gamma of 0.65.

Kodak Film Speed	Meter Settings	Weston	G. E.
Tungsten 24	Tungsten	6	10

Color Sensitivity: Orthochromatic.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 0.60 to 0.70. The contrast required depends to some extent on the particular color process employed.

Resolving Power: 110 lines per mm. in Kodak SD-21.

Safelight: Wratten Series 2 (deep red).

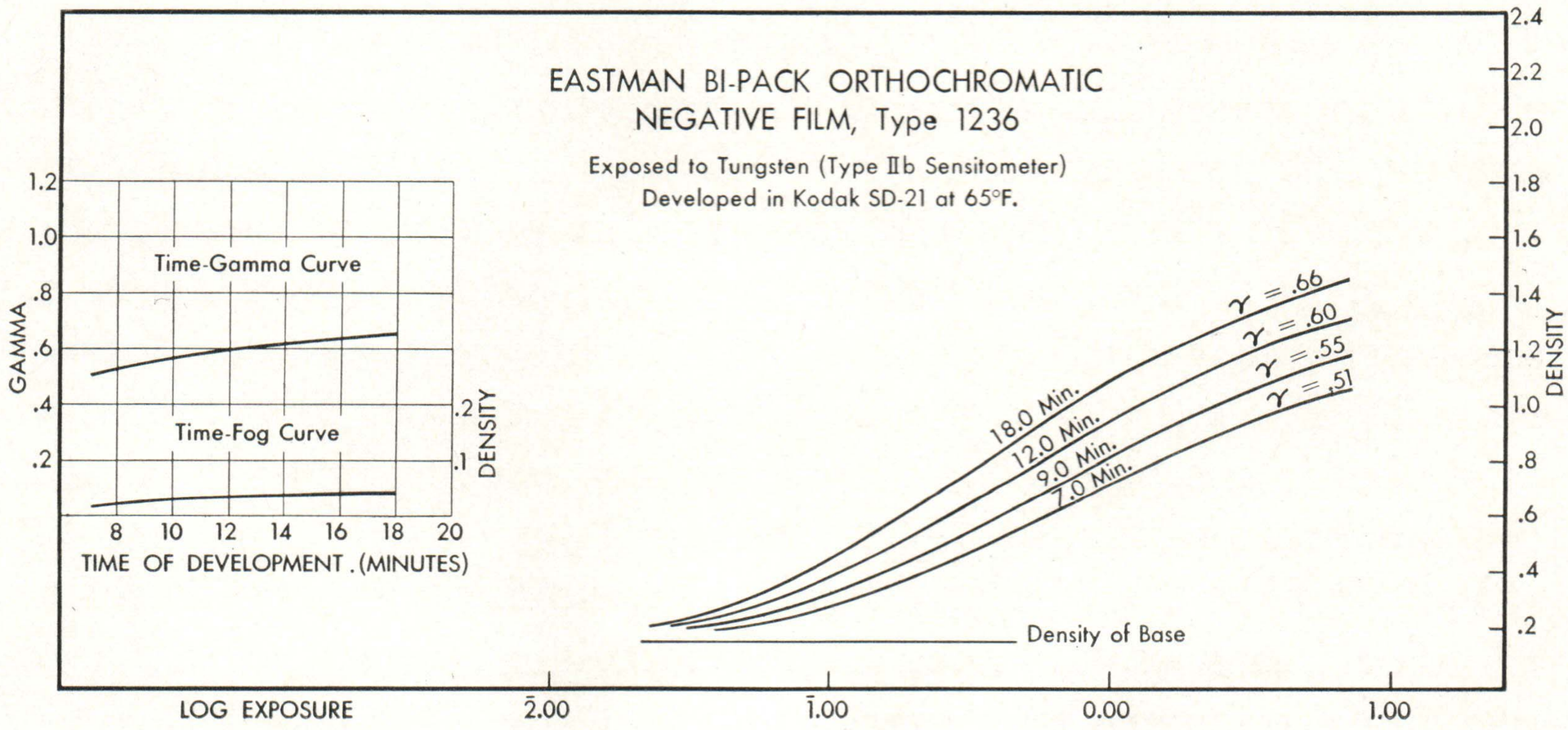
Base: Gray nitrate (approximately two-thirds normal density).

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 400 feet (footage numbered but not frame-line marked). This film is supplied in matched rolls with Bi-Pack Panchromatic, Type *1235*.

Cores and Winding: Type R, wound on (emulsion out).

Identification: The letter C is printed just before the footage number.



Specifications—EASTMAN RELEASE POSITIVE FILM, Type 1301 (35-mm.) and Type 5301 (35- and 16-mm. Safety)

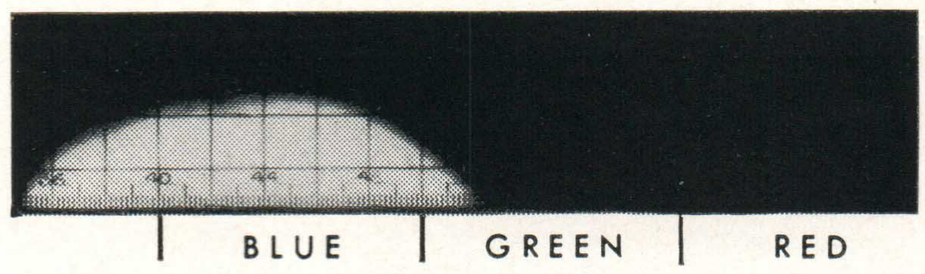
General Properties: A low speed, positive-type emulsion useful for release prints, variable density sound recording (see pages 64 and 68), negative or positive titles, dubbing prints for sound, and other purposes.

Release Positive Exposure Number:

Light Source	Developer	IIb Control Gamma	Rel. Pos. Exp. No.
Tungsten	Kodak D-16	2.10	4500

Color Sensitivity: Blue-sensitive only.

Spectrogram to Tungsten Light



Recommended IIb Control Gamma: For release prints, 2.0 to 2.2.

Resolving Power: 55 lines per mm. in Kodak D-16.

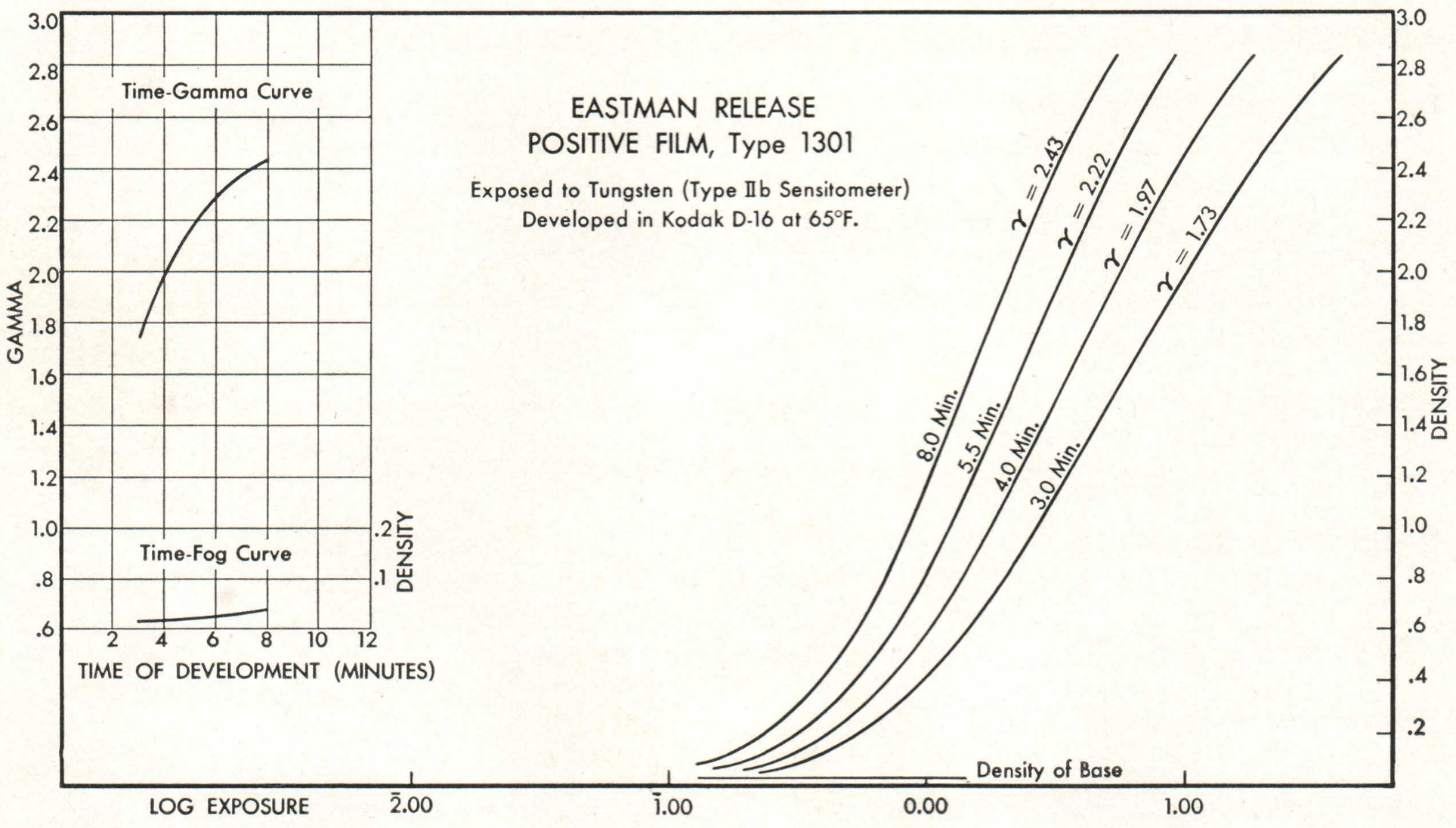
Safelight: Wratten Series 0 or 0A (orange or yellow-green).

Base: Clear. *35-mm.*: Nitrate (*1301*). *16-mm.*: Acetate (*5301*). The 35-mm. width is available on acetate base on request (*5301*). The same emulsion is furnished under the name Eastman News Positive, Type *1401*, on a thinner nitrate base designed for newsreel use, where the life requirement is not so great. Under the general name Eastman Sonochrome Positive, it is also available on a number of tinted nitrate and acetate bases. See page 31.

Perforations: Standard 35-mm. Positive; Standard 16-mm. Silent or Sound (perforated one side). This film is also available on request with Standard 35-mm. Negative perforations and footage numbers, for use in title cameras.

Rolls Available: *1301*: 35-mm. x 200, 400, or 1000 feet. *5301*: 35-mm. x 200, 400, or 1000 feet; 16-mm. x 200, 400, 800, or 1200 feet. *1401*: 35-mm. x 1000 feet. *Sonochrome:* 35-mm. x 200, 400, or 1000 feet; 16-mm. x 200 or 400 feet. All 35-mm. Positive is frame-line marked.

Cores and Winding: *35-mm.*: 200- and 400-foot lengths on Type A core, inserted, or Type R core, wound on (negative perforations for title cameras); 1000-foot lengths on Type U core, wound on. *16-mm.*: All lengths on Type T core.



Specifications—EASTMAN FINE GRAIN RELEASE POSITIVE FILM, Type 1302 (35-mm.) and Type 5302 (35- and 16-mm. Safety)

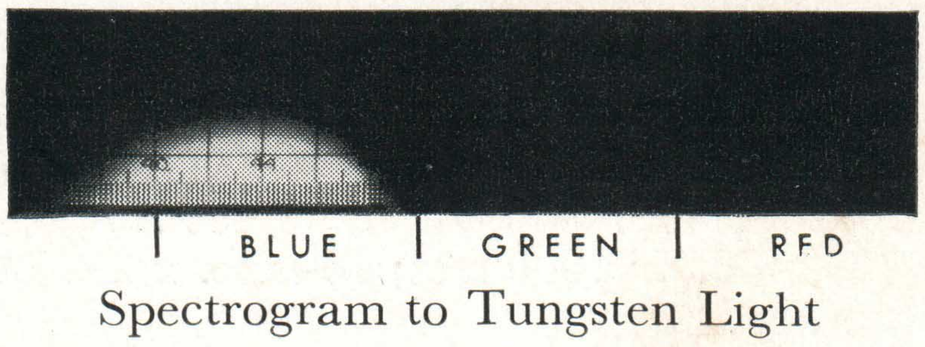
General Properties: An extremely fine grain release positive material of approximately one-fifth the speed of the regular Release Positive, Type *1301*. Because of its fine grain, high resolving power, and image sharpness, it produces prints of excellent definition and general quality, particularly when used in conjunction with the fine grain Eastman duplicating materials. *1302* is also useful for sound recording (see pages 64 and 69), negative or positive titles, dubbing prints for sound, and other purposes. When it is used for release positive printing, a considerable improvement in sound reproduction is obtainable.

Release Positive Exposure Number:

Light Source	Developer	IIb Control Gamma	Rel. Pos. Exp. No.
Tungsten	Kodak D-16	2.50	900

Because of the fine-grain character of the image, the light transmitted by a *1302* print during projection is scattered less than the light transmitted by a *1301* print. *1302* should therefore be developed to a higher density and contrast than *1301* to avoid the lighter and less contrasty quality which would otherwise result on the screen.

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 2.4 to 2.6.

Resolving Power: 90 lines per mm. in Kodak D-16.

Safelight: Wratten Series 0 or 0A (orange or yellow-green).

Base: Clear. *35-mm.*: Nitrate (*1302*). *16-mm.*: Acetate (*5302*). The 35-mm. width is available on acetate base on request (*5302*). The same emulsion is furnished under the name Eastman Fine Grain News Positive, Type *1402*, on a thinner nitrate base designed for newsreel use, where the life requirement is not so great.

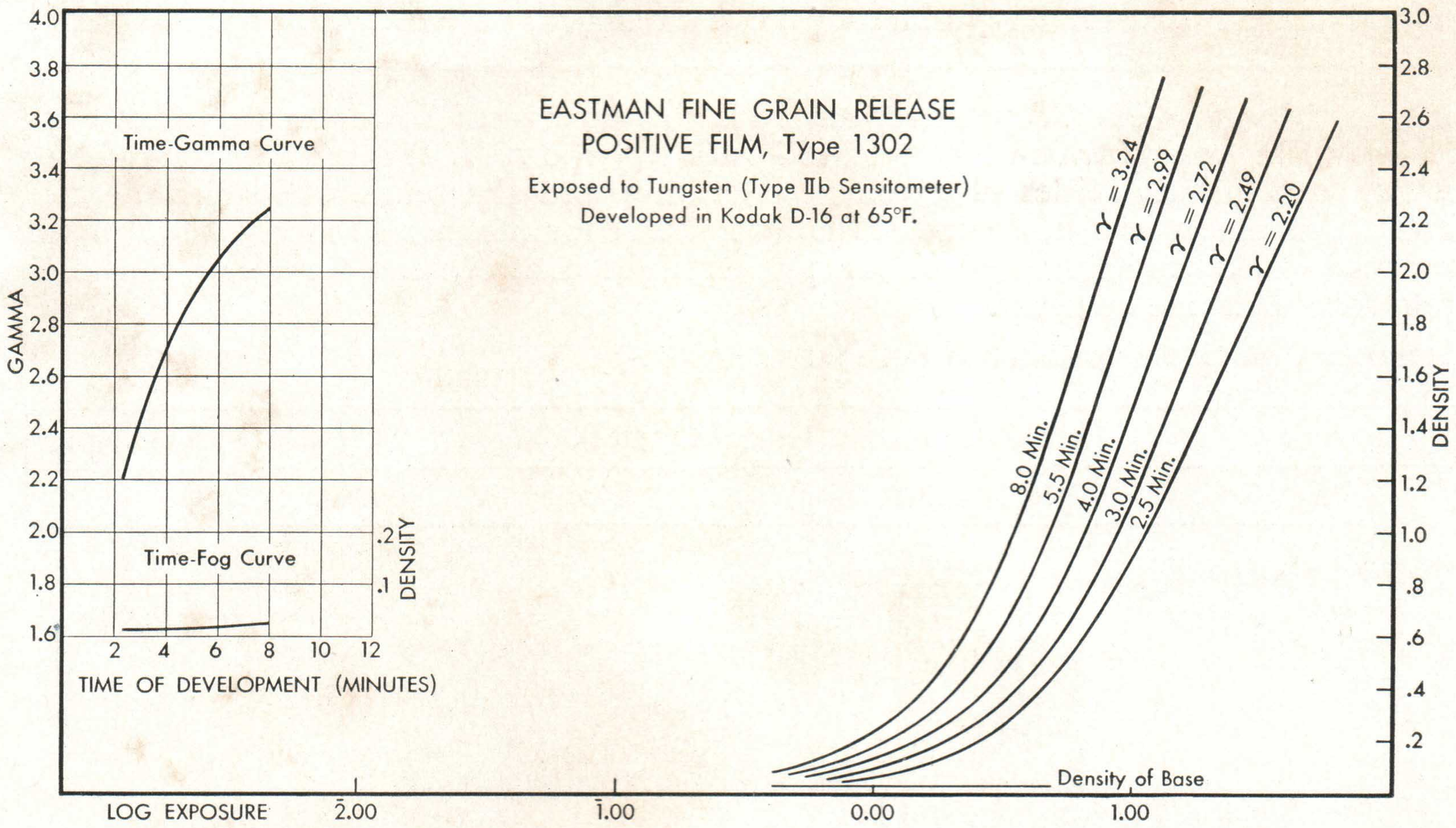
Under the general name Eastman Fine Grain Sonochrome Positive, the same emulsion is also available on a number of tinted nitrate and acetate bases. The characteristics of these bases are discussed on page 31.

Perforations: Standard 35-mm. Positive; Standard 16-mm. Silent or Sound (perforated one side). The 35-mm. width is also available on request with Standard 35-mm. Negative perforations and footage numbers, for use in title cameras.

Rolls Available: *1302:* 35-mm. x 200, 400, or 1000 feet. *5302:* 35-mm. x 200, 400, or 1000 feet; 16-mm. x 200, 400, 800, or 1200 feet. *1402:* 35-mm. x 1000 feet. *Fine Grain Sonochrome:* 35-mm. x 200, 400, or 1000 feet; 16-mm. x 200 or 400 feet. All 35-mm. Fine Grain Positive is frame-line marked.

Cores and Winding: *35-mm.*: 200- and 400-foot lengths on Type A core, inserted, or Type R core, wound on (negative perforations for title cameras); 1000-foot lengths on Type U core, wound on. *16-mm.*: All lengths on Type T core.

Sensitometric Curves:



Note—Exposure of Fine Grain Materials: The speeds of Fine Grain Release Positive, Type *1302*, Fine Grain Duplicating Positive, Type *1365*, and Fine Grain Panchromatic Duplicating Negative, Type *1203*, are such that most production printers do not provide sufficient exposure without some increase in the illumination or decrease in the printer speed. In the Model D Bell & Howell Printer, for example, 300- to 1000-watt projection-type tungsten lamps are required for operation at 60 to 90 feet per minute. When such large lamps are used, cooling devices in the printer lamphouse are necessary. Smaller lamps can be used, but the lower printer speeds they entail are in most cases inconsistent with laboratory production requirements.

Alternatively, a reflector and optical system can be used to collect the light from a 100-watt lamp and deliver it to the printing aperture with higher efficiency. This method of securing more exposure involves precise adjustment of the reflector in order to secure even illumination at the printer gate, but is adapted to printers equipped with drop bar resistance boards for modulating the exposure. Specific information on the installation of reflector systems can be obtained on request from the Motion Picture Film Department, Eastman Kodak Company.

In a number of laboratories, it has been found more practical to substitute a capillary-type mercury vapor lamp for the normal tungsten lamp. In this way sufficient actinic light is obtained with less heat. Mercury vapor lamps cannot, however, be used in printers equipped with drop bar resistance boards. The choice of a printing source is naturally dependent upon the design and adaptability of the printers available.

When mercury vapor lamps (or tungsten lamps with ultraviolet filters) are employed, the spectral quality of the light is such that the contrast of the printed image is lowered. To compensate for this loss of contrast, the development gamma of control strips exposed on the Eastman Type IIb Sensitometer should be raised.

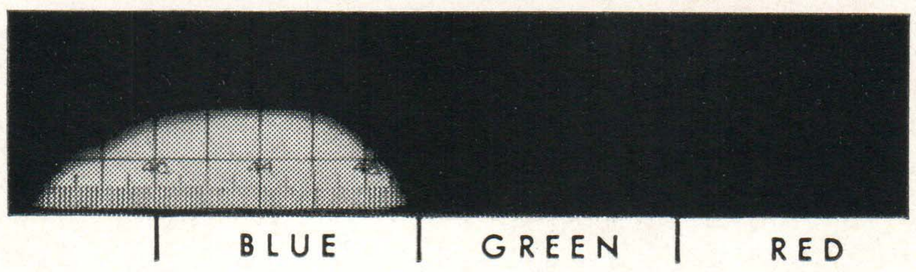
Specifications—EASTMAN HIGH CONTRAST POSITIVE FILM, Type 1363 (35-mm.) and Type 5363 (35- and 16-mm. Safety)

General Properties: A positive emulsion of somewhat lower speed and considerably higher contrast than Release Positive, Type *1301*. It is suitable for making negative or positive titles of excellent definition and sharpness when clear whites and dead blacks are desired. *1363* is also useful for making silhouette mattes for process work, traveling mattes for printer light control, and for other purposes requiring extreme contrast.

Release Positive Exposure Number:

Light Source	Developer	IIb Control Gamma	Rel. Pos. Exp. No.
Tungsten	Kodak D-16	3.75	3000

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 3.5 to 4.8.

Resolving Power: 95 lines per mm. in Kodak D-16.

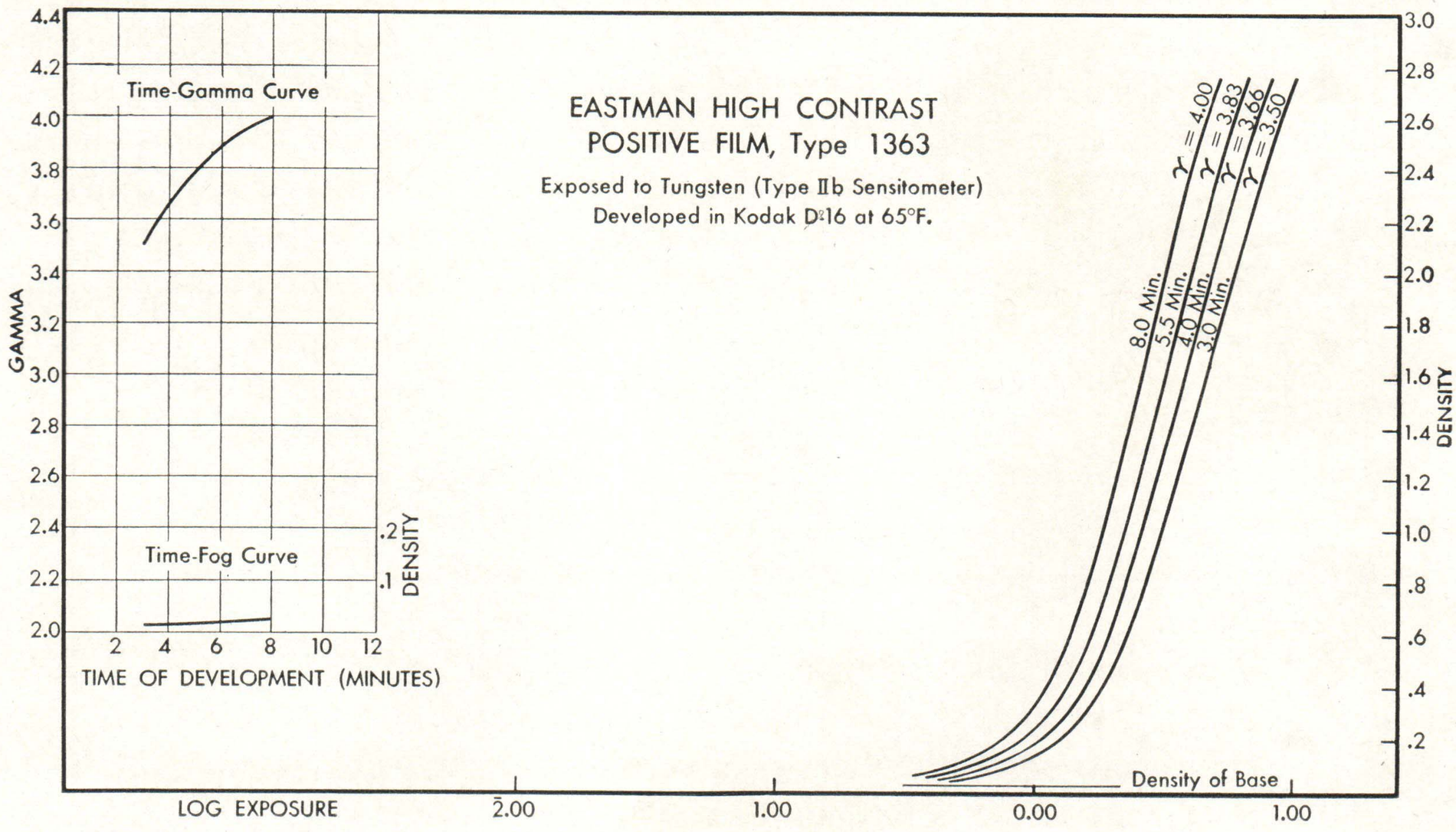
Safelight: Kodak Wratten Series 0 or 0A (orange or yellow-green).

Base: Clear. *35-mm.*: Nitrate (*1363*). *16-mm.*: Acetate (*5363*). The 35-mm. width is available on acetate base on special order (*5363*).

Perforations: Standard 35-mm. Positive; Standard 16-mm. Silent or Sound (perforated one side).

Rolls Available: 35-mm. x 1000 feet (footage numbered and frame-line marked); 16-mm. x 200, 400, 800, or 1200 feet.

Cores and Winding: 35-mm. on Type R core, wound on; 16-mm. on Type T core, wound on. Winding B is used with 16-mm. perforated one side.



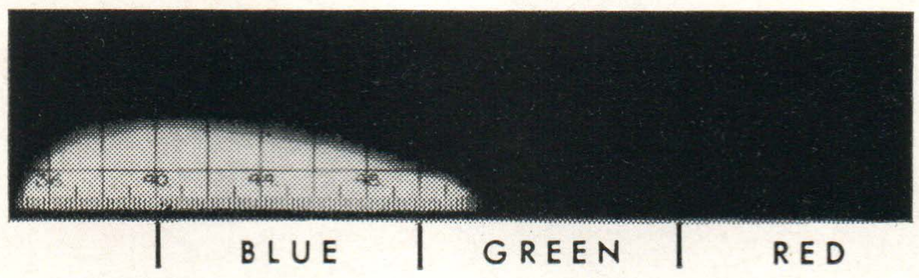
Specifications—EASTMAN DUPLITIZED POSITIVE FILM, Type 1509

General Properties: A low speed positive material specifically designed for making two-color release prints. The film base is coated with emulsion on both sides, each emulsion containing yellow dye to prevent an exposure on one side from affecting the other. The yellow dye also reduces the contrast; this is a desirable effect because the dye toning normally used to make the color prints intensifies the contrast of the silver image.

Release Positive Exposure Number:

Light Source	Developer	IIb Control Gamma	Rel. Pos. Exp. No.
Tungsten	Kodak D-16	1.30	700

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: Approximately 1.30 for clear tungsten exposure. The contrast required depends to some extent on the particular color process employed.

Resolving Power: 95 lines per mm. in Kodak D-16.

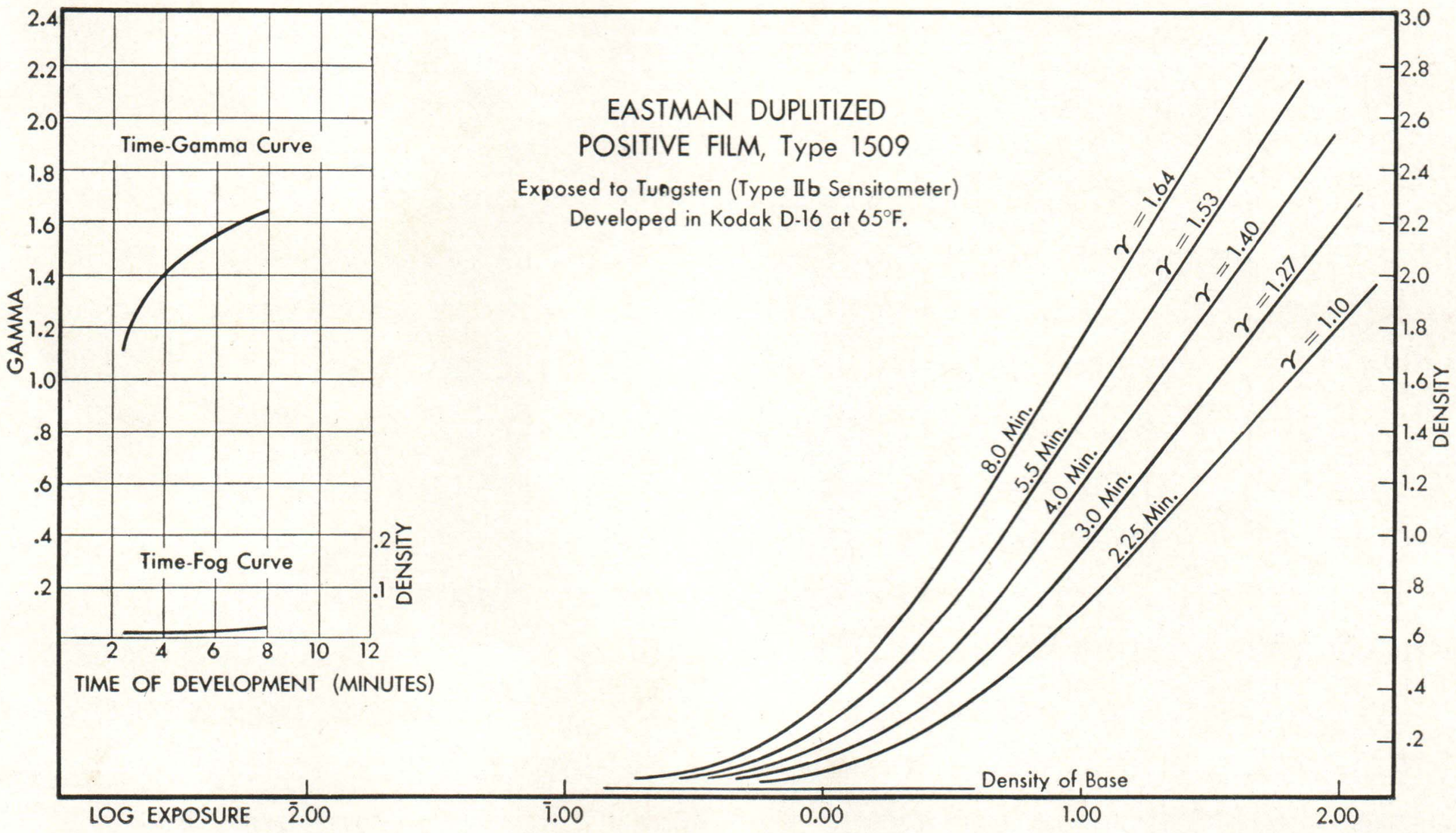
Safelight: Wratten Series 0 or 0A (orange or yellow-green).

Base: Clear nitrate. This emulsion can be obtained on clear acetate base on special order (*5509*).

Perforations: Standard 35-mm. Negative.

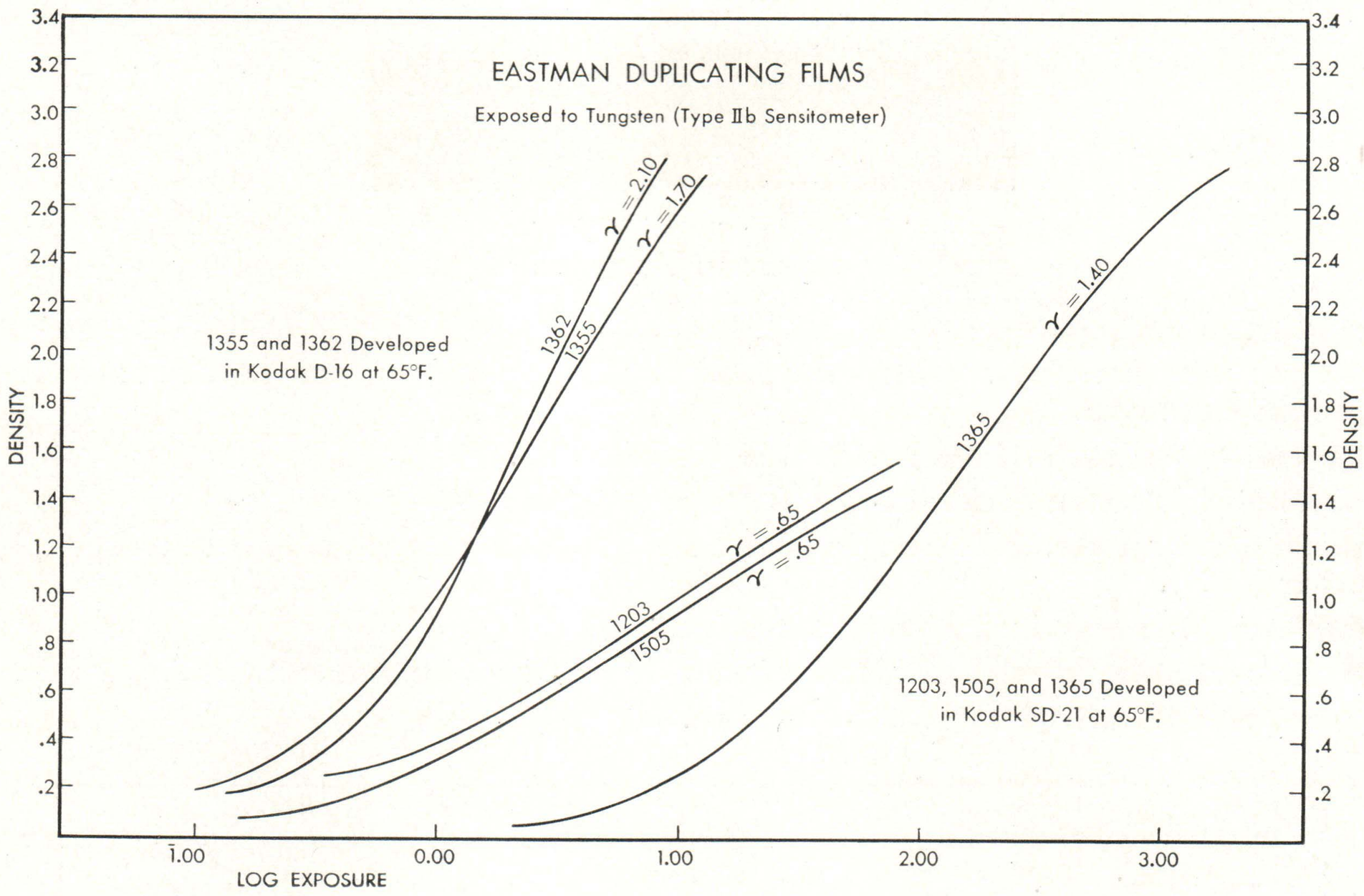
Rolls Available: 35-mm. x 1000 feet (frame-line marked, but not footage numbered).

Cores and Winding: Type U, wound on.



EASTMAN DUPLICATING FILMS

EXCEPT when the original negative has printing characteristics which require correction, the ideal of duplicating work is to secure duplicate negatives which are indistinguishable from the original negative. Correspondingly, prints from the duplicate negatives should equal in every way the quality of prints from the original negative.



To achieve such results, it is necessary to employ emulsions of very low graininess, good latitude, high resolving power, proper characteristic curve shape, and sufficient speed for use in optical printers. When release prints are to be made on Fine Grain Release Positive, Type *1302*, Fine Grain Panchromatic Duplicating Negative, Type *1203*, and Fine Grain Duplicating Positive, Type *1365*, are particularly recommended for use as intermediate materials.

Duplicating films are regularly furnished visibly footage numbered and frame-line marked, with Standard Negative perforations. The negative materials are supplied in 1000-foot rolls, while the positive materials are supplied in either 400- or 1000-foot rolls; both negative and positive materials are furnished on Type U cores, wound on.

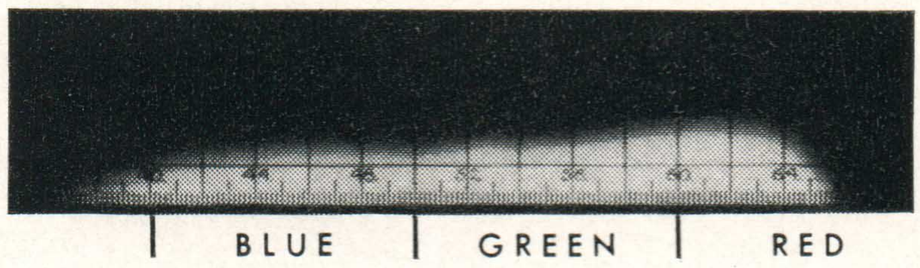
Specifications—EASTMAN FINE GRAIN PANCHROMATIC DUPLICATING NEGATIVE FILM, Type 1203 (35-mm.) and Type 5203 (35- and 16-mm. Safety)

General Properties: A low speed panchromatic duplicating negative material of extremely fine grain and high resolving power, coated on the same type of gray base used for panchromatic picture negative materials. Used as a companion film to Fine Grain Duplicating Positive, Type *1365*, it produces duplicate negatives equal in tone rendering and printing detail to the original negative. The panchromatic sensitivity of *1203* gives it considerably more speed than the same emulsion would have if not sensitized.

Duplicating Negative Exposure Number: See also note on page 55.

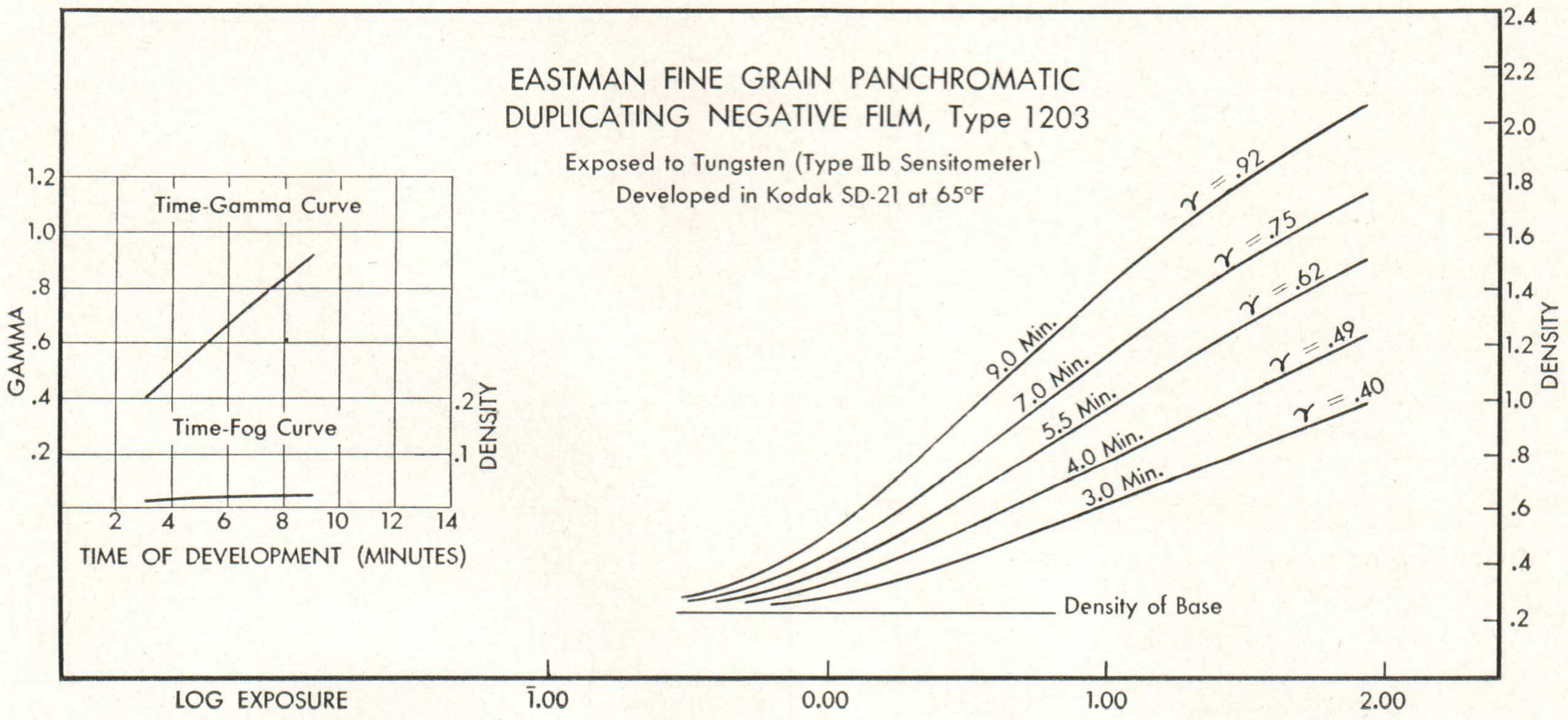
Light Source	Developer	IIb Control Gamma	Dup. Neg. Exp. No.
Tungsten	Kodak SD-21	0.65	600

Color Sensitivity: Panchromatic.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 0.60 to 0.70, same as original negative.
Resolving Power: 110 lines per mm. in Kodak SD-21.
Safelight: Wratten Series 3.
Base: *35-mm.*: Gray nitrate (*1203*). *16-mm.*: Blue-gray acetate (*5203*). The 35-mm. width is available on acetate base on special order (*5203*).
Perforations: Standard 35-mm. Negative; Standard 16-mm. Silent or Sound (perforated one side).
Rolls Available: 35-mm. x 1000 feet (footage numbered and frame-line marked); 16-mm. x 400 or 1200 feet.
Cores and Winding: 35-mm. on Type U core, wound on; 16-mm. on Type T core, wound on. Winding B is used with 16-mm. perforated one side.
Identification: The letter D is printed just before the footage number.



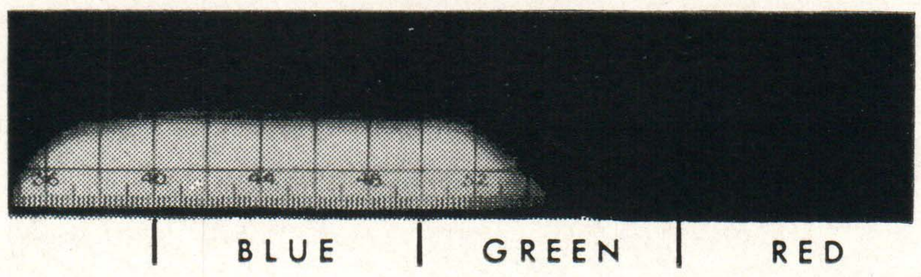
Specifications—EASTMAN DUPLICATING NEGATIVE FILM, Type 1505

General Properties: A low speed, yellow-dyed duplicating negative material. The addition of yellow dye to this fine-grain, non-color-sensitive emulsion reduces the scattering of light within the emulsion, extends the latitude or exposure range, and lowers the maximum contrast. The result is an emulsion which has fine grain with high resolving power, and the latitude and low contrast required in a material for duplicate negatives.

Duplicating Negative Exposure Number:

Light Source	Developer	IIb Control Gamma	Dup. Neg. Exp. No.
Tungsten	Kodak SD-21	0.65	450

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Filters: The Wratten No. 39 (Duplicating) Filter is sometimes used to control or alter contrast in printing *1505*. Because of differences in the color temperatures of printing lamps, it is not possible to assign a definite factor to the filter when it is used in this manner.

Recommended IIb Control Gamma: 0.60 to 0.70., same as original negative.

Resolving Power: 75 lines per mm. in Kodak SD-21.

Safelight: Wratten Series 2 (deep red).

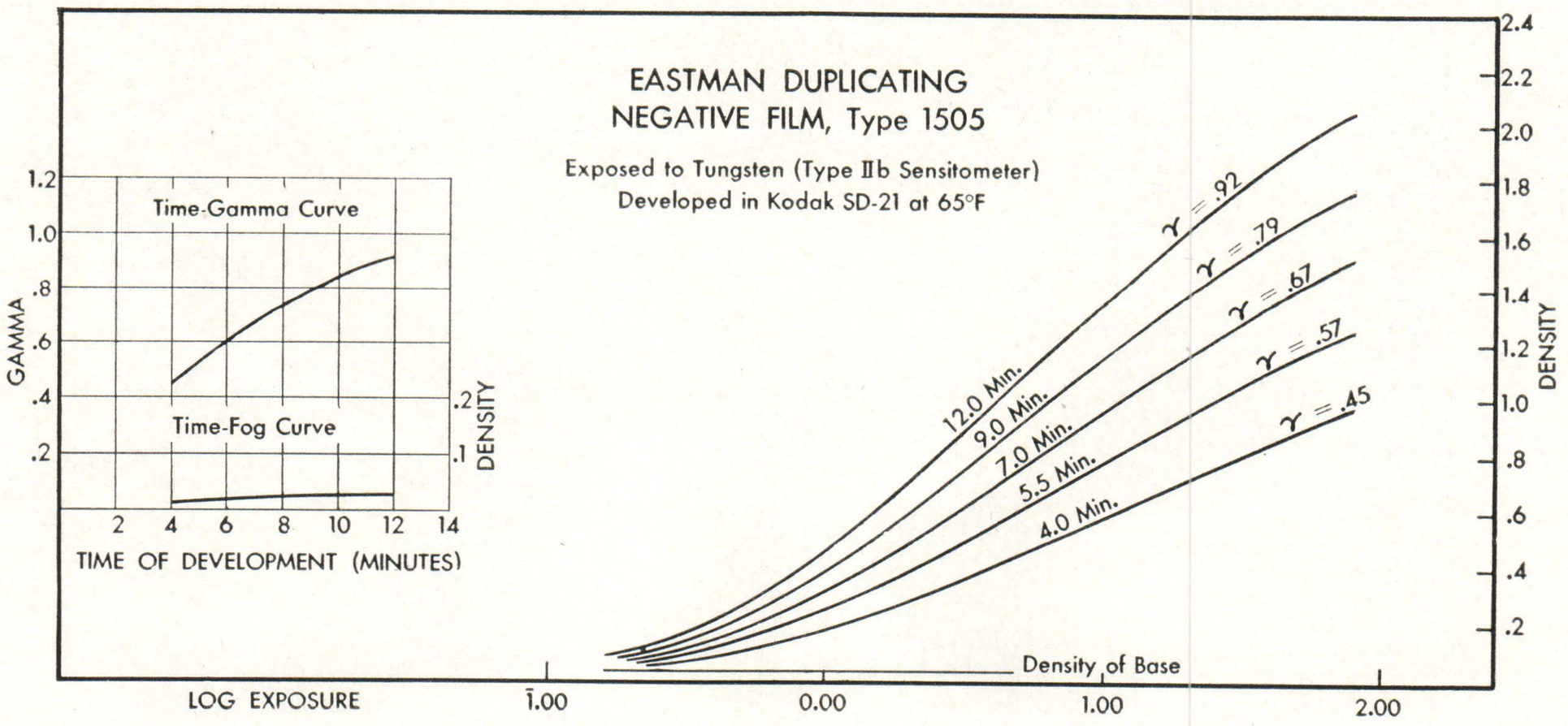
Base: Clear nitrate.

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 1000 feet (footage numbered and frame-line marked).

Cores and Winding: Type U, wound on.

Identification: The letter D is printed just before the footage number.



Specifications—EASTMAN DUPLICATING POSITIVE FILM, Type 1355

General Properties: A lavender base duplicating positive material of approximately the same graininess characteristics as Release Positive, Type *1301*. For equal times of development in the same developer, *1355* is somewhat higher in speed and lower in contrast. It has a long scale of gradation and is especially suited to work requiring gammas up to about 1.9.

Duplicating Positive Exposure Number:

Light Source	Developer	IIb Control Gamma	Dup. Pos. Exp. No.
Tungsten	Kodak D-16	1.70	3000

Color Sensitivity: Blue-sensitive only.

Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 1.6 to 1.9.

Resolving Power: 50 lines per mm. in Kodak D-16.

Safelight: Wratten Series 0 or 0A (orange or yellow-green).

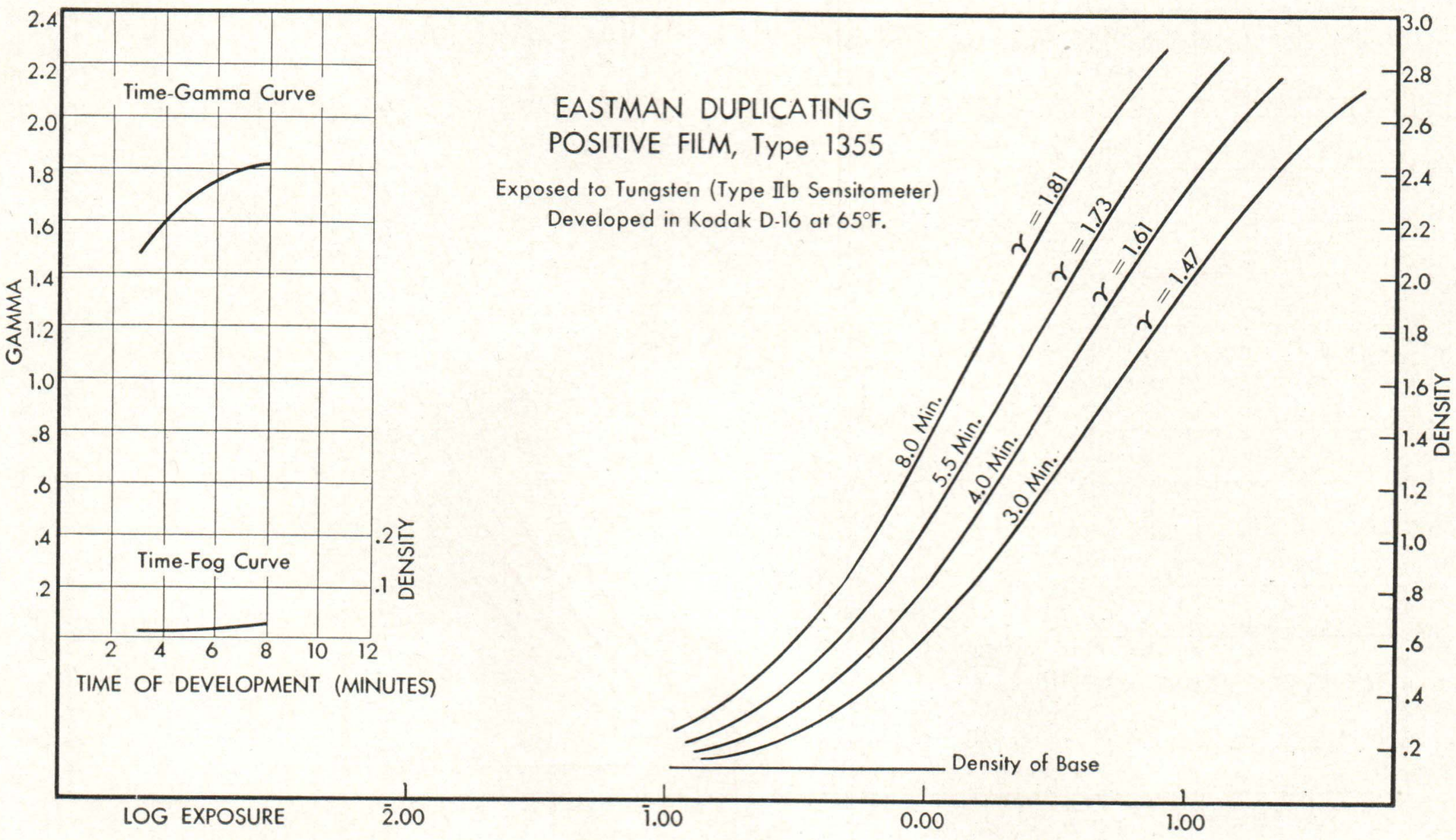
Base: Lavender nitrate.

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked).

Cores and Winding: Type U, wound on.

Identification: The letter D is printed just before the footage number.



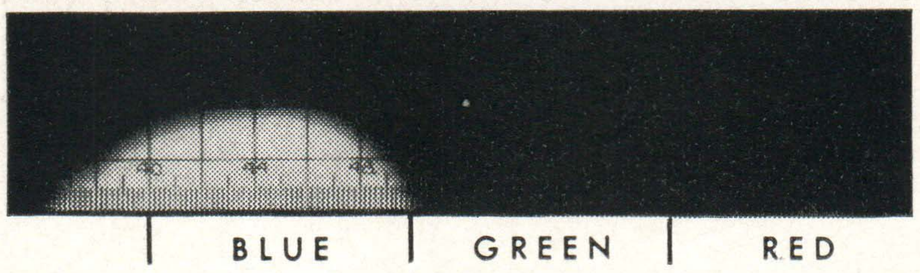
Specifications—EASTMAN HIGH CONTRAST DUPLICATING POSITIVE FILM, Type 1362 (35-mm.) and Type 5362 (35- and 16-mm. Safety)

General Properties: A lavender base duplicating positive material similar in speed and contrast characteristics to Release Positive, Type *1301*. It is capable of giving higher contrast than the regular Duplicating Positive, Type *1355*, when this feature is desirable.

Duplicating Positive Exposure Number:

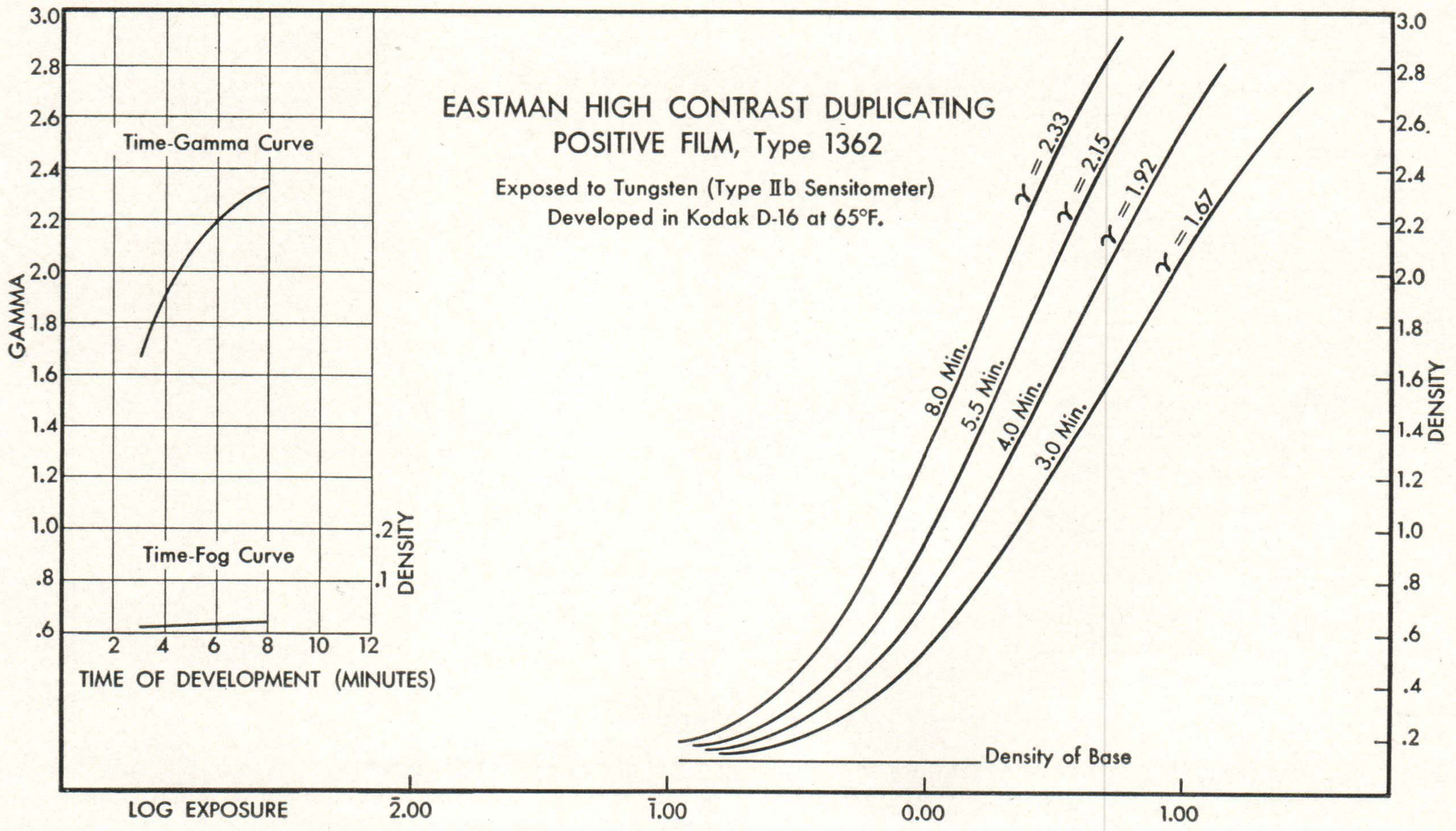
Light Source	Developer	IIb Control Gamma	Dup. Pos. Exp. No.
Tungsten	Kodak D-16	2.10	3100

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 2.0 to 2.3.
Resolving Power: 55 lines per mm. in Kodak D-16.
Safelight: Wratten Series 0 or 0A (orange or yellow-green).
Base: Lavender. *35-mm.*: Nitrate (*1362*). *16-mm.*: Acetate (*5362*). The 35-mm. width is available on acetate base on special order (*5362*).
Perforations: Standard 35-mm. Negative.
Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked).
Cores and Winding: Type U, wound on.
Identification: The letter D is printed just before the footage number.



Specifications—EASTMAN FINE GRAIN DUPLICATING POSITIVE FILM, Type 1365 (35-mm.) and Type 5365 (35- and 16-mm. Safety)

General Properties: A slow, yellow-dyed master positive material of extremely low graininess and exceptionally high resolving power, intended as a companion film to Fine Grain Panchromatic Duplicating Negative, Type *1203*. The use of these two films together results in duplicates distinguishable from the originals only by skilled observers. Special exposure conditions are necessitated by the low speed of *1365*, but they are fully justified by the quality obtainable.

Duplicating Positive Exposure Number: See also note on page 55.

Light Source	Developer	IIb Control Gamma	Dup. Pos. Exp. No.
Tungsten	Kodak SD-21	1.40	100

Color Sensitivity: Blue-sensitive only.

Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 1.2 to 1.6. The image produced by normal development has a distinct warm tone due to its extreme fineness of grain. As a consequence, the printing contrast is appreciably higher than the visual contrast.

Resolving Power: 150 lines per mm. in Kodak SD-21.

Safelight: Wratten Series 0 or 0A (orange or yellow-green).

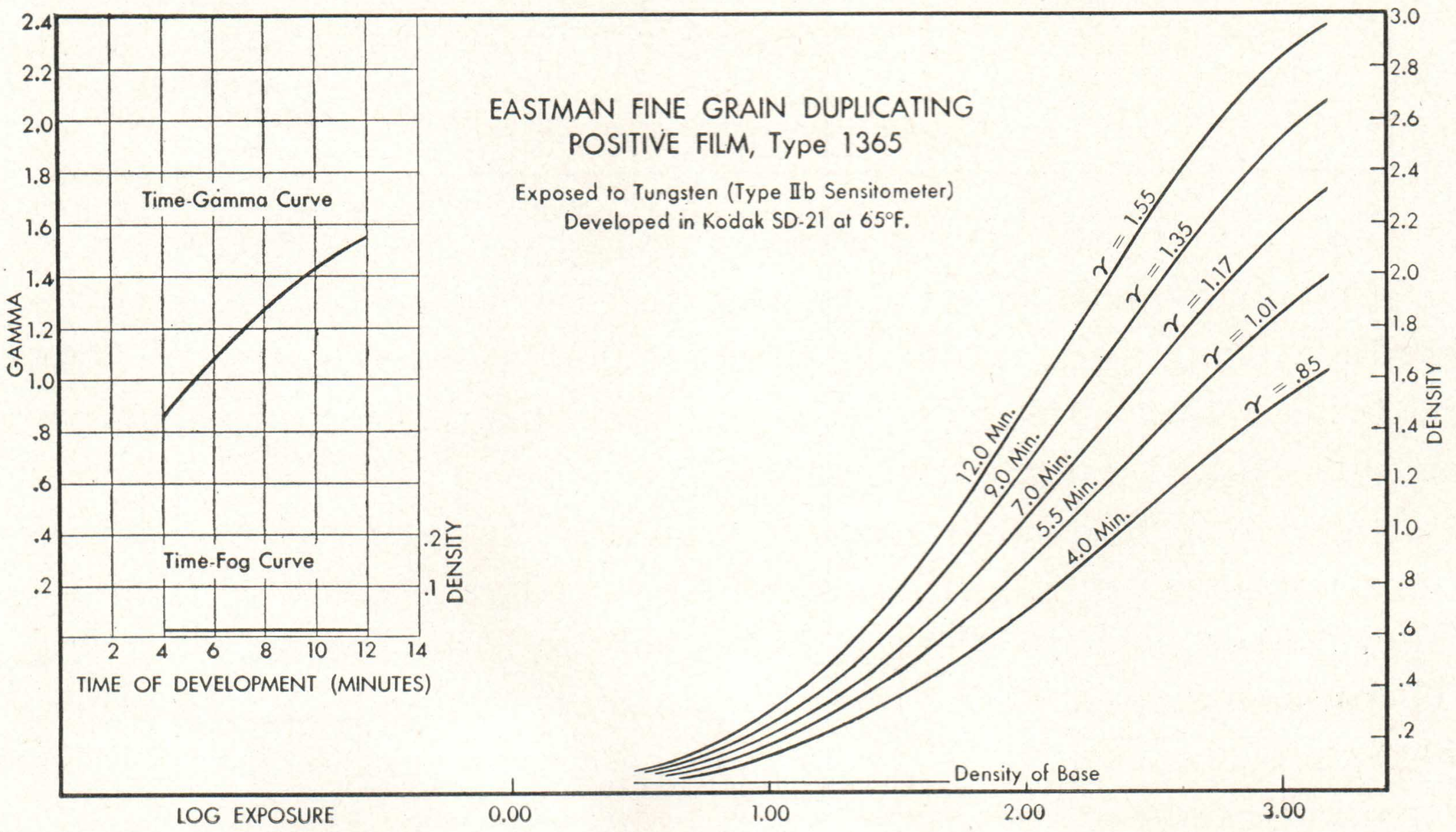
Base: Clear. *35-mm.*: Nitrate (*1365*). *16-mm.*: Acetate (*5365*). The 35-mm. width is available on acetate base on special order (*5365*).

Perforations: Standard 35-mm. Negative; Standard 16-mm. Silent or Sound (perforated one side).

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked); 16-mm. x 200 or 400 feet.

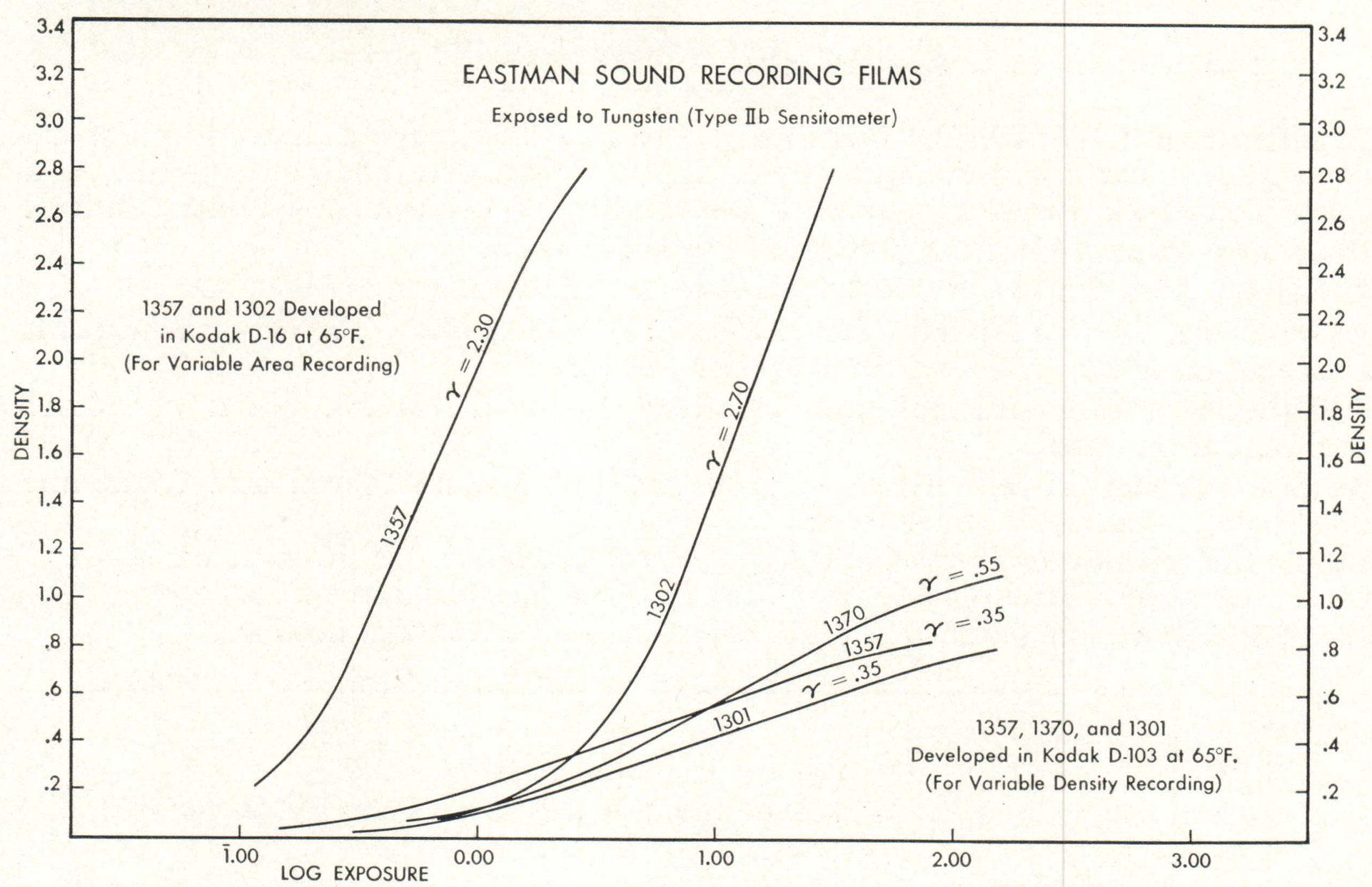
Cores and Winding: 35-mm. on Type U core, wound on; 16-mm. on Type T core, wound on. Winding B is used with 16-mm. perforated one side.

Identification: The letter D is printed just before the footage number.



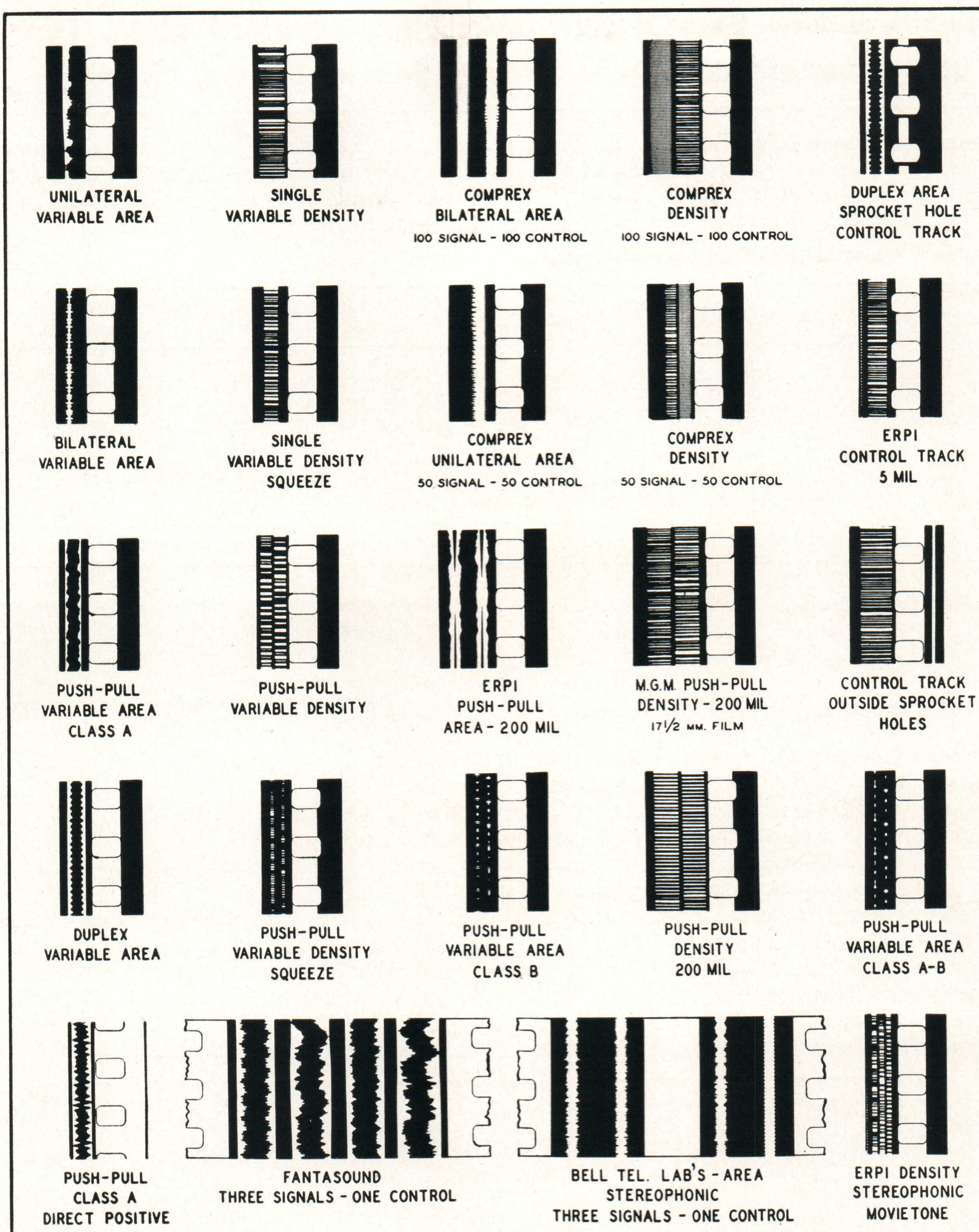
EASTMAN SOUND RECORDING FILMS

THE TWO methods of sound recording in general use, variable density and variable area, require quite different film contrast characteristics. For variable density recording, a long scale at low contrast is necessary to insure distortion-free reproduction. For variable area recording, on the other hand, a much higher contrast is desirable so that the exposed areas will develop to a high density while the unexposed areas remain clear; the boundary between the two must be as sharp as possible.



The other emulsion requirements are similar for both types of recording. Among the most important of these are low graininess, high resolving power, sufficient speed for use in available equipment, and suitable characteristic curve shape.

Sound recording materials are regularly furnished visibly footage numbered and frame-line marked, with Standard Positive perforations. They are supplied in 400- or 1000-foot rolls on Type R cores, wound on. These specifications apply to Release Positive, Type *1301*, and to Fine Grain Release Positive, Type *1302*, when these materials are furnished for sound recording use.



TYPES OF SOUND TRACKS

The illustration* above shows all of the types of sound tracks in common use, as well as a number of interesting experimental types. Some of the latter have been used commercially to a limited extent when the installation of special reproducing equipment was possible.

NOTE: The Corning No. 584 Filter used in determining exposure numbers for ultraviolet filtered exposure was 0.75 mm. thick for variable area recording and 1.5 mm. thick for variable density recording.

*Courtesy Electrical Research Products Division, Western Electric Company.

Specifications—EASTMAN SOUND RECORDING FILM, Type 1357 (35-mm.) and Type 5357 (35- and 16-mm. Safety)

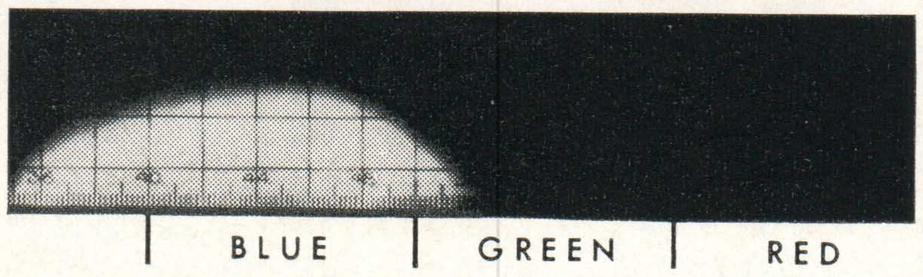
General Properties: Suitable for both variable density and variable area recording. For variable density it provides the maximum emulsion speed consistent with other requirements for this type of recording, and for variable area recording it can be used with either ultraviolet or white light exposure.

Sound Recording Exposure Numbers:

Light Source	Filter	Developer	IIb Control Gamma	Sound Track Density	Sound Rec. Exp. No.
Tungsten	None	Kodak D-16	2.30	1.50*	13000
Tungsten	584	Kodak D-16	2.30	2.10	630
Tungsten	None	Kodak D-103	0.35	0.55	900
Tungsten	None	Kodak D-103	0.55	0.55	4300
Mercury (85-watt)	None	Kodak D-103	0.35	0.55	3200
Mercury (85-watt)	None	Kodak D-103	0.55	0.55	16600
Mercury (85-watt)	584	Kodak D-103	0.35	0.55	600
Mercury (85-watt)	584	Kodak D-103	0.55	0.55	2800

*For a density of 2.10, the Exp. No. is 7000. This offers a means of estimating the 584 filter factor.

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: For variable area recording, 2.0 to 2.5; for variable density recording, 0.35 to 0.55.

Resolving Power: 50 lines per mm. in both Kodak D-16 and Kodak D-103.

Safelight: Wratten Series 0 or 0A (orange or yellow-green).

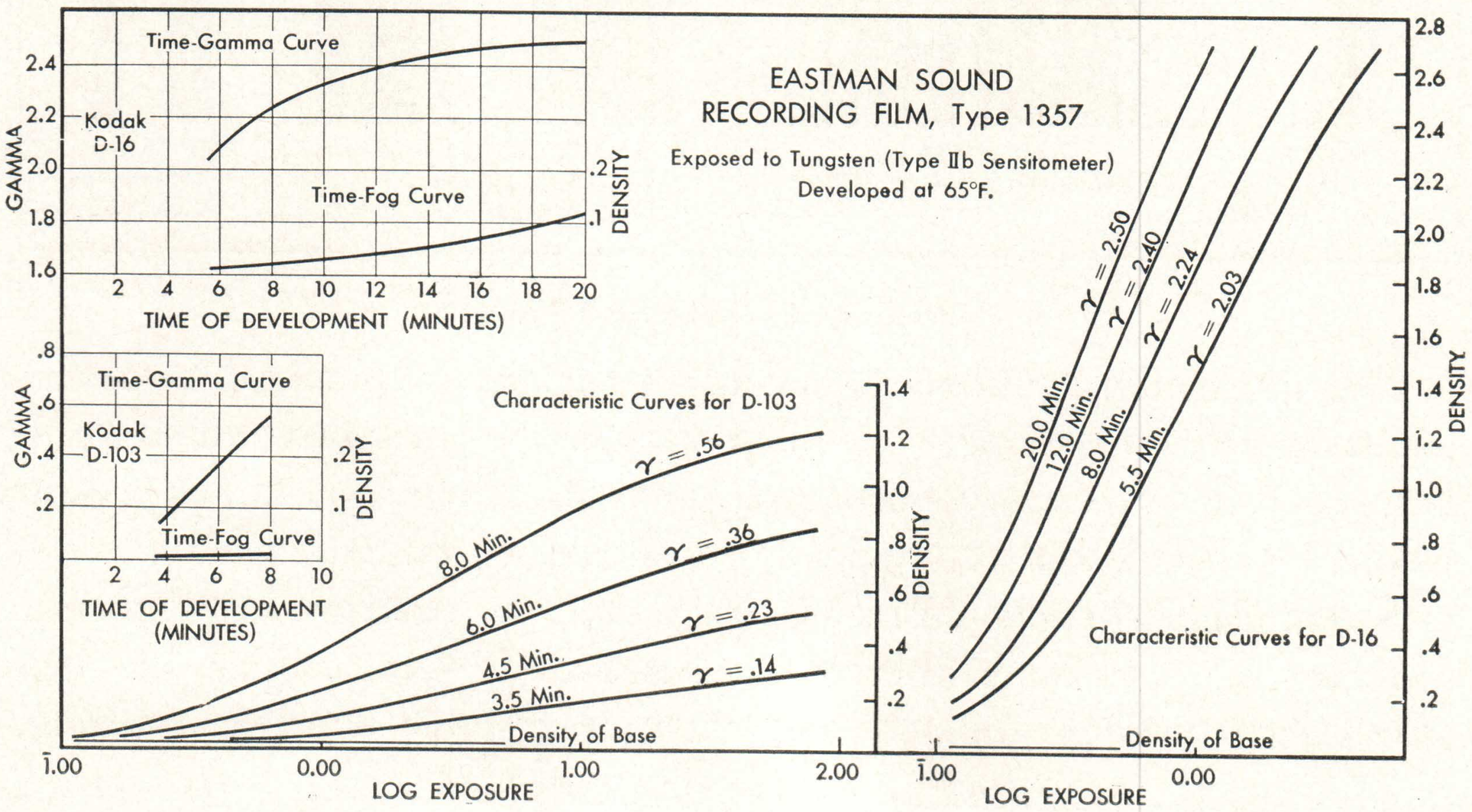
Base: Clear. *35-mm.*: Nitrate (*1357*). *16-mm.*: Acetate (*5357*). The 35-mm. width is available on acetate base on special order (*5357*).

Perforations: Standard 35-mm. Positive; Standard 16-mm. Sound (perf. one side).

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked); 16-mm. x 200 or 400 feet.

Cores and Winding: 35-mm. on Type R core, wound on; 16-mm. on Type T core, wound on. Winding A is used with 16-mm.

Identification: The letter S is printed just before the footage number.



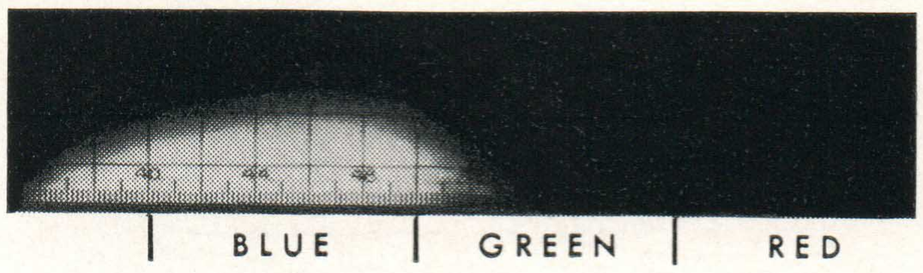
Specifications—EASTMAN FINE GRAIN SOUND RECORDING FILM, Type 1370

General Properties: A fine grain material of high resolving power designed for variable density recording. Although this film is slower than Sound Recording, Type *1357*, or Release Positive, Type *1301*, its speed is sufficiently high to permit exposure with a tungsten lamp in any standard variable density recorder of the light-valve type. Because of its extremely fine grain, it has a lower inherent noise level than either *1357* or *1301*. The use of *1370* is recommended when prints are made on Fine Grain Release Positive, Type *1302*, particularly where ultraviolet exposure is used in the sound printer.

Sound Recording Exposure Numbers: For development in Kodak D-103.

Light Source	Filter	IIb Control Gamma	Sound Track Density	Sound Rec. Exp. No.
Tungsten	None	0.35	0.55	90
Tungsten	None	0.55	0.55	470
Mercury (85-watt)	None	0.35	0.55	220
Mercury (85-watt)	None	0.55	0.55	1170
Mercury (85-watt)	584	0.55	0.55	230

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 0.35 to 0.55.

Resolving Power: 90 lines per mm. in Kodak D-103.

Safelight: Kodak Wratten Series 0 or 0A (orange or yellow-green).

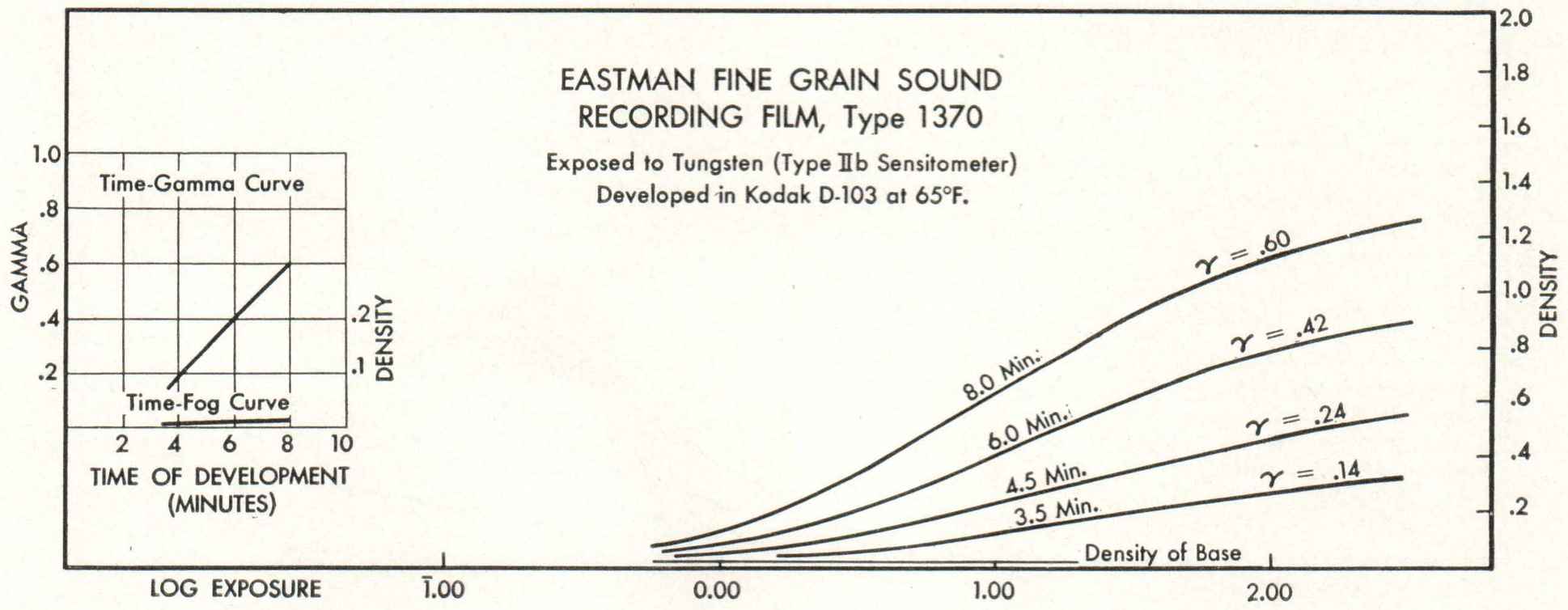
Base: Clear nitrate.

Perforations: Standard 35-mm. Positive.

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked).

Cores and Winding: Type R, wound on.

Identification: The letter S is printed just before the footage number.



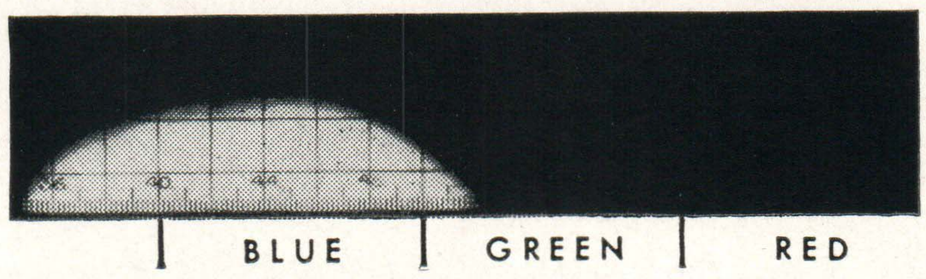
Specifications—EASTMAN RELEASE POSITIVE FILM, Type 1301 (35-mm.) and Type 5301 (35- and 16-mm. Safety) For Sound Recording

General Properties: This is the regular Release Positive emulsion provided with footage numbers. It is suited by development in a low contrast negative developer to variable density sound recording with the light-valve. Although *1301* is slower than Sound Recording, Type *1357*, and requires a higher lamp current for correct exposure, its inherent film noise is lower.

Sound Recording Exposure Numbers: For development in Kodak D-103.

Light Source	Filter	IIb Control Gamma	Sound Track Density	Sound Rec. Exp. No.
Tungsten	None	0.35	0.55	330
Tungsten	None	0.55	0.55	1400
Mercury (85-watt)	None	0.35	0.55	1100
Mercury (85-watt)	None	0.55	0.55	5000
Mercury (85-watt)	584	0.35	0.55	280
Mercury (85-watt)	584	0.55	0.55	1170

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 0.35 to 0.55.

Resolving Power: 55 lines per mm. in Kodak D-103.

Safelight: Wratten Series 0 or 0A (orange or yellow-green).

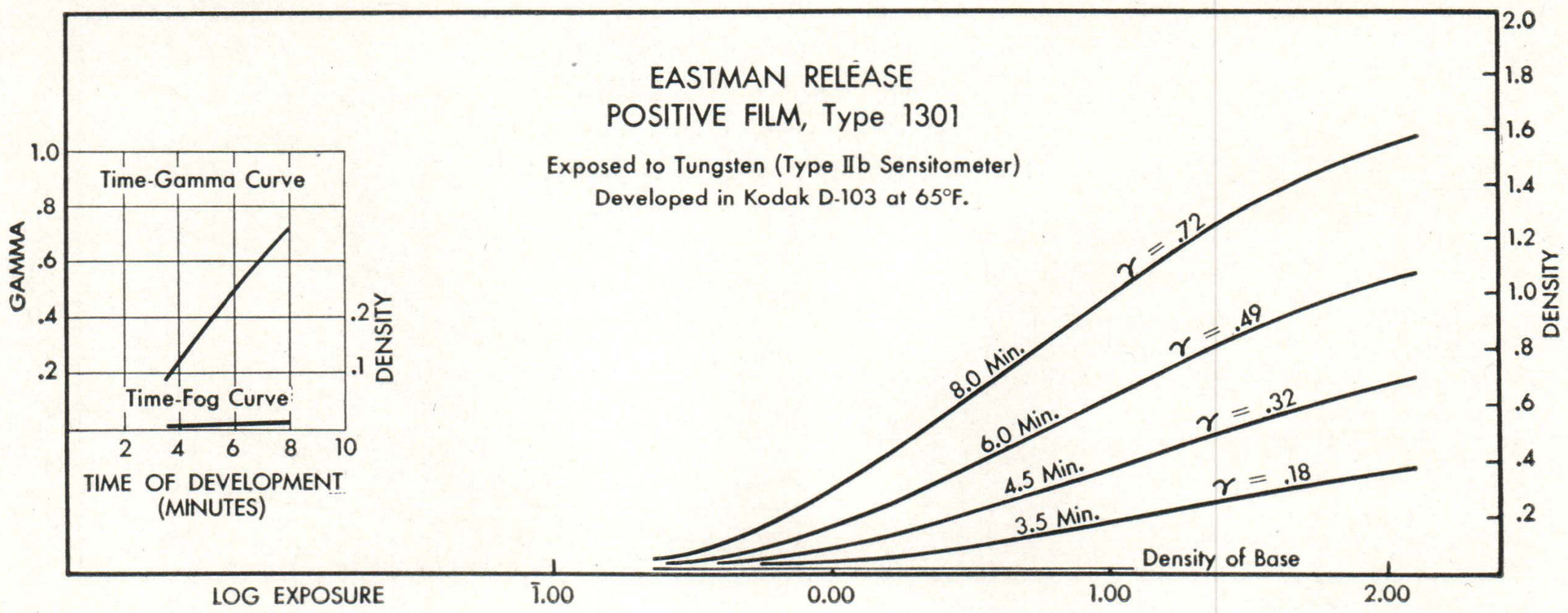
Base: Clear. *35-mm.*: Nitrate (*1301*). *16-mm.*: Acetate (*5301*). The 35-mm. width is available on acetate base on special order (*5301*).

Perforations: Standard 35-mm. Positive; Standard 16-mm. Sound (perforated one side).

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked); 16-mm. x 200, 400, 800, or 1200 feet.

Cores and Winding: 35-mm. on Type R core, wound on; 16-mm. on Type T core, wound on. Winding B is used with 16-mm.

Identification: This film does not bear an identifying letter.



Specifications—EASTMAN FINE GRAIN RELEASE POSITIVE FILM, Type 1302 (35-mm.) and 5302 (35- and 16-mm. Safety) For Sound Recording

General Properties: This is the regular Fine Grain Release Positive emulsion, provided with footage numbers. It is suited by development in a high contrast positive developer to variable area recording.

Sound Recording Exposure Numbers: For exposure without a filter.

Light Source	Developer	IIb Control Gamma	Sound Track Density	Sound Rec. Exp. No.
Tungsten	Kodak D-16	2.70	2.10	270

Color Sensitivity: Blue-sensitive only.

Spectrogram to Tungsten Light

Recommended IIb Control Gamma: For variable area recording, 2.6 to 2.8.

Resolving Power: 90 lines per mm. in Kodak D-16.

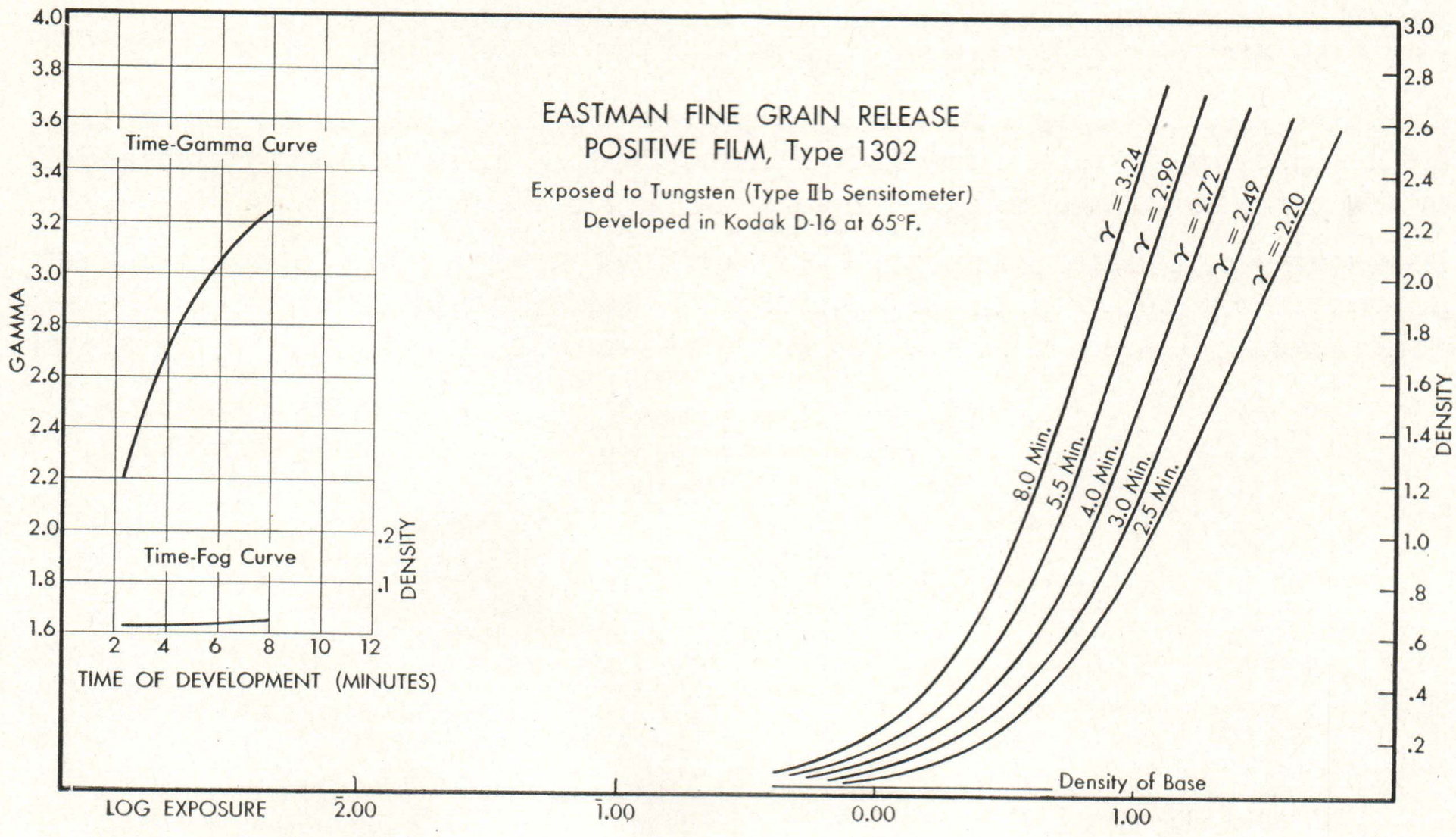
Safelight: Wratten Series 0 or 0A (orange or yellow-green).

Base: Clear. *35-mm.*: Nitrate (*1302*). *16-mm.*: Acetate (*5302*). The 35-mm. width is available on acetate base on special order (*5302*).

Perforations: Standard 35-mm. Positive; Standard 16-mm. Sound (perforated one side).

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked); 16-mm. x 200, 800, or 1200 feet.

Cores and Winding: 35-mm. on Type R core, wound on; 16-mm. on Type T core, wound on. Winding B is used with 16-mm.



Specifications — EASTMAN LEADER STOCK — Nitrate (35-mm.) and Safety (35- and 16-mm.)

NITRATE LEADER

All nitrate leader is of the 35-mm. width and is supplied on Type U cores (domestic orders, wound on; export orders, inserted) in 1000-foot rolls. The rolls are packed in individual black paper envelopes, two to the can, but the cans are not packed in individual cartons, except on export orders. On special order, nitrate leader is available perforated otherwise than indicated in the following paragraphs.

Eastman No. 3 Title Stock. Transparent uncoated support approximately 0.00538 in. thick. Standard 35-mm. Positive perforations.

Eastman No. 3 Machine Leader. Transparent uncoated support approximately 0.00538 in. thick. May contain scratches or various other defects. Standard 35-mm. Positive perforations.

Eastman No. 3 Blue Machine Leader. Transparent blue uncoated support approximately 0.00538 in. thick. Standard 35-mm. Positive perforations.

Eastman No. 3 Blue White Machine Leader. Blue support with white pigment coating on one side, approximately 0.0055 in. thick. Standard 35-mm. Positive perforations.

Eastman No. 6 Machine Leader. Transparent uncoated support approximately 0.0075 in. thick. Oversize positive-type perforations.

Eastman No. 6 Blue Machine Leader. Transparent blue uncoated support approximately 0.0075 in. thick. Oversize positive-type perforations.

Eastman No. 6 Blue White Machine Leader. Blue support with white pigment coating on one side, approximately 0.00790 in. thick. Oversize positive-type perforations.

SAFETY LEADER

Safety leader is supplied in 35-mm. (on Type U cores) and 16-mm. (on Type T cores) widths as indicated in the following paragraphs. Both 35-mm. and 16-mm. rolls are packed in individual black paper envelopes, but 16-mm. rolls are not packed in individual cans. Instead, they are packed ten rolls to the can, with the exception of lengths over 400 feet, which are packed two rolls to the can.

Eastman No. 3 Safety Leader. Transparent uncoated support approximately 0.0055 in. thick. 35-mm. x 100 to 1000 feet. Standard 35-mm. Positive perforations or not perforated. Available on special order in the 16-mm. width.

Eastman No. 6 Safety Leader. Clear or blue transparent uncoated support approximately 0.0075 in. thick. 16-mm. x 100 to 800 feet (Standard 16-mm. Silent perforations); 35-mm. x 100 to 800 feet (Standard 35-mm. Positive perforations).

Appendix • LOGARITHMS IN SENSITOMETRY

What Logarithms Are

The figures given for exposure units on characteristic curves are logarithms of the actual exposures in meter-candle-seconds. The logarithm (log) of a number is the power to which 10 must be raised to give the number. Thus:

$10^2 = 10 \times 10$	$= 100$	Therefore, log 100	$= 2$
$10^1 = 10$	$= 10$	log 10	$= 1$
$10^0 = 10/10$	$= 1$	log 1	$= 0$
$10^{-1} = 10/10 \times 10$	$= .1$	log 0.1	$= -1$ (written $\bar{1}$)
$10^{-2} = 10/10 \times 10 \times 10$	$= .01$	log 0.01	$= -2$ (written $\bar{2}$), etc.

Intermediate numbers can also be expressed in logarithms. Take, for example, the numbers between 1 and 10:

$10^{0.30} = 2$	Therefore, log 2 $= 0.30$	$10^{0.78} = 6$	Therefore, log 6 $= 0.78$
$10^{0.48} = 3$	log 3 $= 0.48$	$10^{0.85} = 7$	log 7 $= 0.85$
$10^{0.60} = 4$	log 4 $= 0.60$	$10^{0.90} = 8$	log 8 $= 0.90$
$10^{0.70} = 5$	log 5 $= 0.70$	$10^{0.95} = 9$	log 9 $= 0.95$

How Logarithms Are Used

The use of logarithms makes it possible to carry out many types of computation with relative ease, even computations involving much more complex numbers than those used here for illustrative purposes. A table of logarithms or a slide rule (which has logarithmic scales) is employed, depending on the accuracy required.

For example, two numbers can be multiplied by adding their logarithms; the result is the logarithm of their product. Conversely, two numbers can be divided by subtracting their logarithms; the result is the logarithm of their quotient. Thus:

20×4	$= 80$	$20 \div 4$	$= 5$
log 20 + log 4	= log 80	log 20 − log 4	= log 5
1.3 + 0.6	= 1.9 (the log of 80)	1.3 − 0.6	= 0.7 (the log of 5)

It will be noted that the logarithm of 20 is not 0.3 but 1.3. The reason for this is clear if 20 is considered as 10×2. Then log 20 is the sum of the log of 10 (1.0) and the log of 2 (0.3), or 1.3.

Why Logarithms Are Used In Sensitometry

Logarithms are used on characteristic curves in order to present the response of the photographic emulsion in the same terms that the eye sees tone differences in the original subject. For example, suppose that

a room is illuminated only by one 25-watt lamp. If a second 25-watt lamp is turned on, the observer will see a distinct increase in the illumination in the room. But if a third 25-watt bulb is turned on, the increase will be less distinct. To produce a second increase in the illumination as noticeable as the first one will require two, not one, additional 25-watt bulbs.

So, too, with the photographic emulsion. In the straight line portion of the characteristic curve, a certain density will be produced by exposure to one lamp under certain conditions of lamp-to-film distance and exposure time. If exposure to two lamps under the same conditions produces an increase in the density of, say, 0.2, then a total of four lamps will be required for the next density increase of 0.2, a total of eight lamps for the next, and so on.

Thus, rather than regarding tones which are separated by a constant difference in brightness as equal steps in the tone scale (e.g. 1, 2, 3, 4, where there is a constant difference of 1), both the eye and the emulsion see equal steps between tones which have the same brightness *ratio* to each other (e.g. 1, 2, 4, 8, where the ratio of each number to the preceding one is 2). When exposure, which is merely intensity (illumination) multiplied by time, is expressed in logarithmic terms, such a ratio is represented by a constant difference in log exposure (e.g. 0, 0.3, 0.6, 0.9) and equal steps in the visual tone scale are shown as equal intervals on the exposure scale.

If actual exposure rather than log exposure were used in plotting the characteristic curve, the shadow end of the curve would be very much compressed, while the highlight end would be very much expanded. Furthermore, there would be no straight line portion representing an equal addition of density for each proportional increase in exposure. The range of actual exposure values is so great that such a curve could not be shown on an ordinary page.

Density itself is logarithmic, being defined as the logarithm of the opacity. It is derived as follows:

$$\text{Transmission} = \text{Transmitted Light}/\text{Incident Light}$$

Since the opacity is low if the transmission is high, and vice versa,

$$\text{Opacity (O)} = 1/\text{Transmission (T)}$$

$$\text{and Density (D)} = \log \text{O} = \log (1/\text{T})$$

For example, an image transmitting 1/10 of the light falling on it has an opacity of 10, and hence a density of 1.

Equal density steps anywhere on the scale impress the eye as being equal tone steps. Therefore density and log exposure are the logical units for studying the behavior of light sensitive materials.

Because of conditions brought about by the war emergency, some of the methods and materials used for packing Eastman Motion Picture Films may differ from those described herein.

THE COMMERCIAL USE OF 16-MM. KODACHROME FILM

IN RESPONSE to many requests for information on the commercial use of 16-mm. Kodachrome Film, the following information is offered. Since duplicates rather than original color films are the end product, it is important that the quality of the original picture be primarily suited to duplicating. Originals for duplication must have well-modeled highlights having a density value of 0.35 or more. The density scale must not be excessive, and the highest density of important subject areas should not exceed 2.0. The original must have all the usual good photographic qualities, consistent color, proper contrast, sharpness, steadiness, etc. Since tendencies in over-all color rendition may be increased slightly on duplication, it is well to avoid the slight roll-to-roll variations which are ordinarily of no consequence. For this reason, all the film for the production at hand should be obtained at the same time. For the same reason, if practical, it is desirable to return all the film for processing in one package. If the production takes several weeks or longer, *the exposed rolls should be protected from high humidity and in hot weather should be refrigerated.* Films should never be stored in automobiles. Test rolls made during production should be sent in at intervals for processing to check exposure and suitability.

Camera: Since most commercial films require sound, the camera must be capable of being driven at the rate of 24 frames per second with a synchronous motor, and, of course, should be of the precision-type with built-in special effect devices. The Ciné-Kodak Special meets these requirements. The camera should be checked regularly for definition, cleanliness of lenses and gate, and other operational points. Film chambers should be matched for frame line, which can be adjusted at the factory. All working conditions should be standardized.

STUDIO USE OF KODACHROME FILM TYPE A

Kodachrome Film requires lighting of rather low contrast and *all lamps must have the same definite color quality* of illumination.

Color Temperature: The color quality of the light from tungsten lamps is expressed as color temperature.* Kodachrome Type A is

*Color Temperature is the temperature, expressed in degrees Kelvin, to which a "black body" must be heated, in order to emit light of the color required. The Kelvin scale has its zero at −273° C.

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color-balanced for 3450°K, and it changes in color rendering if the illumination departs by more than 100° from this value. No. 1 Photoflood lamps at rated voltage operate at 3450°K. For No. 2 Photoflood lamps, the value is slightly lower, 3430°K. Other lamps have lower color temperatures; their light is yellower. Increasing the voltage applied to any tungsten lamp raises the color temperature or makes the light bluer; decreasing the voltage drops the color temperature. There are parallel effects in Kodachrome Film color rendering. It is, therefore, important to adjust the voltage to operate all the lamps at or near 3450°K; if this cannot be done, all should be operated at some other single temperature, and a suitable compensating filter should be applied to the camera lens. The color temperature can be checked, and the required filter found by means of the Eastman Color Temperature Meter. (This meter cannot be used with fluorescent lamps.) Eastman Color Compensating Filters for use with this meter are:

Blue filters to raise color temperature	CC3	light	CC13	Yellow filters to lower color temperature
	CC4	medium	CC14	
	CC5			
	CC6	dark	CC15	

The following points should be checked as possible sources of improper color temperature: 1. Wrong line voltage. A. Read voltage at the lamp socket, not at the wall outlet. B. Voltage may vary widely during the day and evening. If possible, avoid hours of heavy load. C. Voltage at the lamps differs between a close-up involving a few lamps and a long-shot with all lamps on. 2. Mixture of different lights, such as Photoflood and Fluorescent. 3. Greenish glass in spotlight lenses.

Lighting Level and Contrast: An illumination level of 650-foot candles is required for Kodachrome Type A exposed at 24 frames per second at *f*/2.8, for a subject of average color. For other apertures, see specifications for Type A Kodachrome. It is important that all colors be uniformly lighted, since in color photography differences between colors provide color contrast. This means that a predominantly front lighting should be employed. The exception is when the subject is all of one color or contains no color contrast, then a side or back-lighting can be used. The general key or modeling lights should be placed first; the lamps used to illuminate the shadow areas arranged last.

The lighting contrast or relative intensity of the key and shadow illumination on the subject can be determined by using a photoelectric exposure meter to measure the illumination (incident light) at various points. The meter used in this manner should have a piece of opal glass placed over the cell window. With most types of meters this should be of such a transmission that the meter will read 1/10 the

value of the normal reading. The meter so fitted should be held *precisely* in the same plane as the subject and pointed toward the light source. Care should be taken that when the shadow illumination is read the meter is shielded so that direct rays from the key lights do not affect it. Such measurements can also be made by reflected light, by placing a white or gray card in the plane of the subject, and by measuring separately the key and shadow light reflected from it.

The permissible ratio of key-to-shadow illumination is somewhat flexible, depending upon the color contrast and extent of light and dark areas of the subject. A satisfactory ratio is 2 or 3 to 1, and for color work should seldom exceed 4 to 1, when duplication is intended. That is, if the key light on the scene produces a meter reading of 400-foot candles, the shadow area should be so illuminated that a reading of at least 100-foot candles will result. This figure for illumination ratio should not be confused with the permissible *brightness range*, which is governed by both the illumination and the reflecting power of the various parts of the scene. The brightness range of small areas, as measured with a photometer, should usually not exceed 20 to 1, if color is to be rendered in the extreme tones.

DAYLIGHT USE OF KODACHROME FILM

Kodachrome Film for daylight is color-balanced for the mixture of sunlight and skylight, characteristic of front lighting, which prevails from two hours after sunrise to two hours before sunset. Earlier or later, sunlight is usually yellower which results in a warm color rendering. While this is effective for some subjects, faces so rendered are unsatisfactory on duplication. Direct and hazy sunlight are both satisfactory, but objects in open shade lighted by blue sky will be bluish.

Reflectors: The ratio of sunlighted highlight to skylighted shadow is usually too high for good color rendition in close-up and near-by scenes, just as it is for good tone rendition in black-and-white. Therefore, suitable reflectors should be used to direct light into the shadow areas and reduce the contrast, especially in side-lighted or back-lighted scenes. For this purpose "hard" and "soft" reflectors can be used. Aluminum paint, tin foil, pure white cardboard, and sometimes mirrors, are employed. When aluminum paint is used on a smooth surface, it provides a "hard," mirror-like spot of bright light. When used on a rough surface, it provides "soft" diffuse light.

Light to Supplement Daylight: In offices and factories illuminated by daylight, supplementary lighting is required which matches daylight in color. Regular Kodachrome Film must be used. One suitable illumi-

nant is the carbon arc-lamp, fitted with white flame carbons and the Brigham Y1 Filter. Another is the 3200° Kelvin lamps with the Macbeth Whiterlite Filters used over the lamps. The carbon lamps supply a higher illumination level, the 3200°K lamps a more constant color source. Another choice is the Blue Photoflood lamp, which will provide a fairly satisfactory color-balance but should not be employed when flesh tones are a part of the scene. Safety-glass used in factory windows is often greenish in color, and may cause false color rendition.

Exposure:

Correct exposure can be determined by the use of illumination or other exposure tables (see specifications) or by the use of the photoelectric exposure meter. To obtain satisfactory results with an exposure meter, it must be calibrated to the camera and lens normally employed. This is done by making an exposure at the stop indicated by the meter and then four others, one-half and one stop larger, one-half and one stop smaller.

The best exposure is determined by projecting the film and the meter setting is altered, if necessary, to conform with the test result. Exposure tables and other aids can be checked in the same way.

In extreme close-up work the effective aperture changes; it can be compensated for as shown by the Effective Lens Aperture Kodaguide.

CHOICE OF COLORS

Considerable thought should be given to the selection of the colors of properties and backgrounds when feasible. Some colors do not photograph exactly as they appear to the eye, therefore, photographic tests should be made before production filming is started. The colors associated with the important part of any scene should be studied, and a background of proper color should be selected so as to provide color contrast for the subject.

The more liberal use of light and medium grays adds considerably to the naturalness of a color film. Color is often used as a spectacle, and as such it does not always appear natural. Therefore, unnecessary colors should be eliminated from the subject. *Brilliant whites and dark colors or blacks should be eliminated whenever possible*, unless carefully controlled light can be used.

It must be remembered that Kodachrome Film is designed to produce satisfactory color pictures. No color film is designed or intended for use as a precise color-measuring or color-comparing device, and it, therefore, may not reproduce very small differences in color.

SOUND

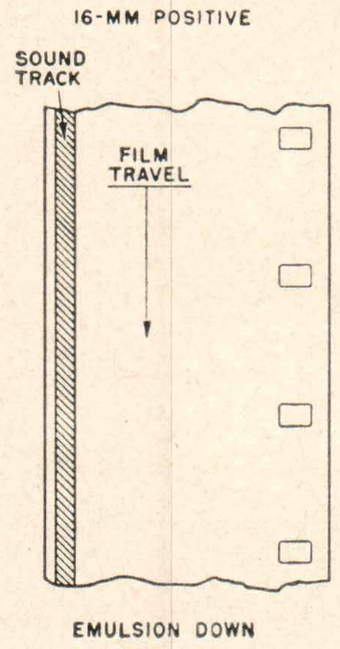
Sound can be recorded simultaneously with the picture, or before or after, for introducing special sound effects, commentary, and so forth. There are three methods in general use for making sound films:

(1) The single system, in which the sound and picture are recorded simultaneously on the same film. The equipment is convenient and suited to news-reel type of work, but there are some disadvantages. First, the processing treatment is determined by picture requirements and is not necessarily the best treatment for the sound track. Second, the editing operation is made very difficult because of the 26-frame interval on the film between corresponding portions of sound and picture. Third, such sound tracks do not duplicate well.

(2) The double system, in which sound and picture are recorded simultaneously and synchronously but on separate films. Each film can thus be processed for best results and editing is simplified. The sound and picture are later combined in one print for projection. This method is extensively used for 16-mm. commercial films.

(3) The system of "dubbing" sound on pictures made with regular silent cameras at 24 frames per second. The edited picture is projected synchronously with a sound recorder, while special sound effects, narration, and so forth are recorded. This sound record is then combined with the picture in the final print.

Sound Tracks Suitable for Duplicating



Kodachrome duplicates of satisfactory quality can be made from 35-mm. or 16-mm. positive sound tracks, either variable density or variable area, provided the tracks are of good quality and made under suitable control conditions. 16-mm. tracks should be oriented as shown in the diagram. Negative tracks are not accepted for duplication.

Negative: The original sound negative should be made under the same sensitometric conditions as if a projection print were to be made. For a variable density negative on *1357* the gamma should be in the range of 0.35 to 0.50, and the density in the range of 0.40 to 0.55. For a variable area negative on *1357* the gamma should be in the range of 2.2 to 2.5 and the density in the range of 1.9 to 2.2.

Master Positive: A variable density master positive should be made under the same sensitometric conditions as would be used for a normal projection print. For a variable area record, if the optimum density of a projection print is about 1.3, the density of a 35-mm.master

Daniel D. Teoli Jr.
Archival Collection

	Variable Density (Tungsten Exposure)			Variable Area (Ultraviolet Exposure)		
	Film	*Density*	*Gamma**	*Film*	*Density*	*Gamma**
Original Negative	*1537* *5357*	0.40-0.55	0.35-0.50	*1357* *5357*	1.9-2.2	2.2-2.5
Master Positive	*1301* *5301*	0.70-0.75	2.2	*1301* *5301*	2.0 1.5-1.6	2.2 2.2

*Type IIb control gamma.

positive from the same negative should be about 2.0 and of a 16-mm. master positive about 1.5 to 1.6.

Tests: It is recommended that, whenever possible, the sensitometric conditions be selected from the results of intermodulation or cross-modulation tests printed from about a 10-foot section of negative made under normal negative conditions. Prints with a series of densities, in steps of 0.10 or less, should be made on *1301*, developed to a control gamma of 2.2. The print densities should cover a range of from 0.40 to 1.00 for a variable density track; or a range of 1.2 to 2.2 for variable area. Measurements on Kodachrome duplicates made from these prints will indicate the optimum master positive density.

If such intermodulation or cross-modulation tests cannot be made, samples of speech and music should be recorded and printed by the above procedure. The optimum master positive density can then be determined by listening to the Kodachrome duplicates.

These tests should be repeated at periodic intervals.

EDITING

The Kodachrome original should be protected from scratches and possible damage in handling. For projection, cutting and editing, it is suggested that a black-and-white duplicate be made of the Kodachrome original. All of the editorial work can now be done on this duplicate and the Kodachrome original cut to match it. Some studios enlarge the 16-mm. Kodachrome original up to 35-mm. black-and-white so that standard 35-mm. apparatus can be used in editing.

STORAGE OF FINISHED FILM

To insure longest life, the finished film should be wound firmly without cinching on the reel and stored in a metal film can. The blotter in the can should not be moistened. Films should be stored at a temperature of 40° to 50°F. and a relative humidity of 40% to 50%. Avoid storing films near steam pipes or in damp cellars.

Specifications—16-mm. KODACHROME SAFETY FILM, Type A

This film is color-balanced for use with Photoflood Lamps, specifically for 3450°K. It is available perforated on both sides for silent or on one side for sound cameras.

Light Sources and Filters Required:

Light Source	Color Temp. °K—120 Volts	Filter Required
No. 1 Photoflood	3450	No filter
No. 2 Photoflood	3430	No filter
No. 4 Photoflood	3415	No filter
Movie flood	3410	No filter
R2 Photoflood	3430	No filter
3200°K lamps	3200	CC4
Mazda CP lamps	3380	No filter
Fluorescent lamps (Not recommended for best color rendition.)		
White	3500	CC34
Daylight	6500	Type A Kodachrome Filter for Daylight (No. 85)
White flame arc	5000	(Determine by photographic test)
High intensity "sun" arc	5500	
Daylight mixture Sunlight and skylight	6100	Type A Kodachrome Filter for Daylight (No. 85)

Meter Settings: Photoflood—Weston 12, G. E. 20; Sunlight, with Type A Kodachrome Filter for Daylight—Weston 8, G. E. 12.

Illumination (Incident Light) in Foot Candles for Movies and Stills:

Lens Aperture →		*f*/1.9	*f*/2.8	*f*/4.0	*f*/5.6	*f*/8
Type A Kodachrome 16-mm.	Sound 24 frames	300	650	1300	2600	5200
	Silent 16 frames	200	435	870	1740	3500
Kodachrome Professional Type B (Bellows draw 1.2)	1/10 sec.			750	1500	3000
	1 sec.			75	150	300
Miniature Kodachrome K135A, K828A	1/25 sec.	150	325	650	1300	2600
	1 sec.	6	13	26	52	104

This table is for average subjects containing some light, some medium, and some dark colors. If a subject is composed entirely of very light pastel colors at least one-half stop *smaller* should be used. For subjects composed almost entirely of dark colors at least one-half stop larger is recommended.

Slight differences in lamp-to-subject distances affect illumination intensity. Do not move lamps after final light measurement has been taken.

Lamps and Set Size: Approximate number of No. 1 Photoflood lamps required in Kodaflectors, matte side.

Set to be Illuminated	No. of No. 1 Lamps	Amps. Drawn	Distance Lamps-to-Subject	Lens Aperture Required	
				16 frames	24 frames
2x3— 6 sq. ft.	2	4.4	3½ feet	*f*/2.8	*f*/1.9—*f*/2.8
3x4—12 sq. ft.	4	8.8	3½ feet	*f*/4	*f*/2.8—*f*/4
4½x6—27 sq. ft.	8	18	6 feet	*f*/3.5	*f*/2.8
6x8—48 sq. ft.	12	26.4	7 feet	*f*/3.5	*f*/2.8
9x12—108 sq. ft.	32	70	12 feet	*f*/3.5	*f*/2.8

Resolving Power: 75 lines per mm.

Film Sizes: See next page.

Specifications—16-mm. KODACHROME SAFETY FILM (for Daylight)

This film is color-balanced to a mixture of sunlight and skylight from two hours after sunrise and up to two hours before sunset. It is available perforated on both sides for silent cameras or on one side for sound cameras.

Light Sources and Color Temperature Table:

Light Source	Color Temp. °K	Color Results	Filter Required
Noon sunlight—no skylight	5400°	warm	CC light blue
Sunlight plus skylight Midday hours*—few or no clouds in sky	6100°	correct	no filter
Sunlight plus skylight Morning and evening hours† —Few or no clouds in sky	2000°-5000°	very ruddy	
Sunlight—hazy, slightly overcast sky	5800°-5900°	warm	
Totally overcast sky	approx. 6500°	slightly bluish	Kodachrome Haze Filter
Clear skylight alone	12000°-26000°	very bluish	
Regular No. 1 Photofloods‡	3450°	reddish	Kodachrome Filter for Photofloods (No. 80)
White Flame Arc	5000°	bluish	Brigham Y1 (for absorption of ultraviolet)
Daylight Fluorescent‡	6500°		
Daylight Blue Photofloods‡	4800°	reddish	

*For the hours from two hours after sunrise until two hours before sunset.

†For the two hours after sunrise and the two hours before sunset.

‡Not recommended for best color rendering.

Note: The color temperature values given above, which apply to front lighting may vary by 300° to 500°K depending upon the time of year and geographical location.

Daylight Exposure Table: For 24 frames per second. Shutter time 1/45 sec.

Lighting	Basic Exposure—Front Lighting			Side or Back-Lighting Average Subjects
	Average Subjects	*Light-colored Subjects*	*Dark-colored Subjects*	
Bright direct sunlight	Between *f*/5.6 and *f*/8	*f*/8	*f*/5.6	For lighting effect; without reflectors ½ to 1 stop more, with reflectors—approximately same as front lighting. For full shadow detail, allow one stop more. Adjustment must also be made for light and dark-colored subjects—½ stop less or more as the case may be.
Weak, hazy sun No distinct shadows cast	*f*/4.5 or between *f*/4 and *f*/5.6	*f*/5.6	*f*/4	
Overcast sky, cloudy but bright or open shade on bright day	*f*/3.5 or between *f*/2.8 and *f*/4	*f*/4	*f*/2.8	
Heavily overcast sky or in shade on bright day	Between *f*/2 and *f*/2.8	*f*/2.8	*f*/2	

For 16 frames per second, see Ciné-Kodak Outdoor Guide.

Meter Settings: Sunlight—Weston 8, G.E. 12; Photoflood, with Kodachrome Filter for Photoflood (not recommended for best color rendition)—Weston 3, G. E. 5.

Resolving Power—75 lines per mm.

Film Sizes of Interest in Commercial Work: Perforated both sides: 50, 100, 200-foot rolls; Perforated one side: 100, 200, 400-foot rolls.

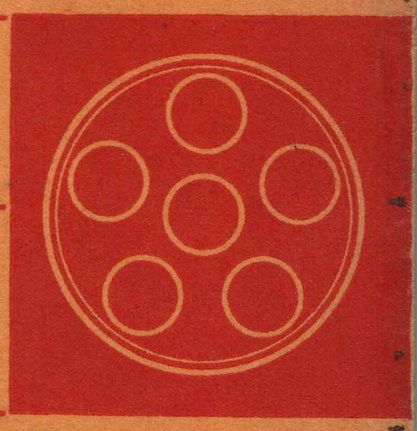
EASTMAN KODAK COMPANY • ROCHESTER, N. Y.

7-42 CH. PRINTED IN UNITED STATES OF AMERICA

ADDITIONAL DATA
ON

Eastman

MOTION PICTURE FILMS FOR PROFESSIONAL USE



Containing Information on Eastman Motion Picture Materials and Processing Methods

The pages in this packet are edge punched for insertion in the book *Eastman Motion Picture Films for Professional Use*

Motion Picture Film Department

EASTMAN KODAK COMPANY • ROCHESTER 4, N. Y.

Specifications — EASTMAN INFRARED NEGATIVE FILM, Type 1210 (Increased Speed)

General Properties: Sensitive to infrared radiation and the blue and far red light of the visible spectrum. This film is 50 per cent faster than the previous Type 1210. The Type 1210 can be exposed with filters ranging from the Wratten No. 15 (G) to the No. 89 to produce unusual effects in sunlight. The infrared sensitivity allows the reproduction of distant detail ordinarily obscured by atmospheric haze. When used in sunlight with a suitable filter, such as the Wratten A or F, to absorb blue light, it produces a realistic illusion of night; the blue sky photographs very dark.

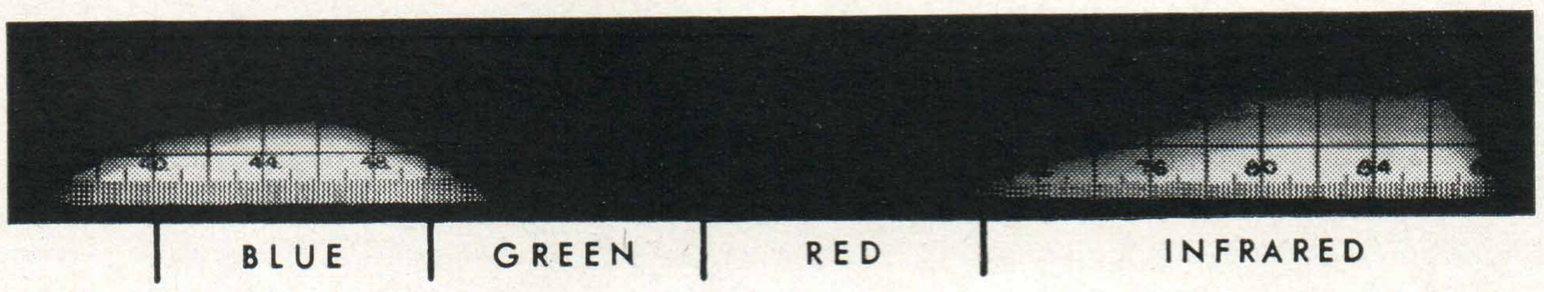
Speed and Recommended Exposure Meter Settings: For exposure through the A or F Filter, and for development in seasoned Kodak D-76 to a gamma of 0.65.

Kodak Film Speed	Meter Settings	Weston	G. E.
Tungsten 6 (Daylight 2)	Tungsten	1.5	2.5

No meter settings are given for daylight since the ratio of infrared to visible radiation in daylight varies considerably, and meters respond principally to visible light. However, this ratio for tungsten light is sufficiently constant to warrant use of a meter.

This film is usually used on location, and for night effects is normally exposed at *f*/4.5 to *f*/6.3 in bright sunlight, using the Wratten A or F Filter. Test strips should be developed to insure that the exposure is correct to give the desired effect.

Color Sensitivity: Blue and far visual red and infrared.



Filters: To obtain infrared effects, a filter must be used. The Wratten G (No. 15), A (No. 25), F (No. 29), and No. 70 are recommended. The Wratten No. 87 or No. 89 can also be used, but require twice the exposure of the others.

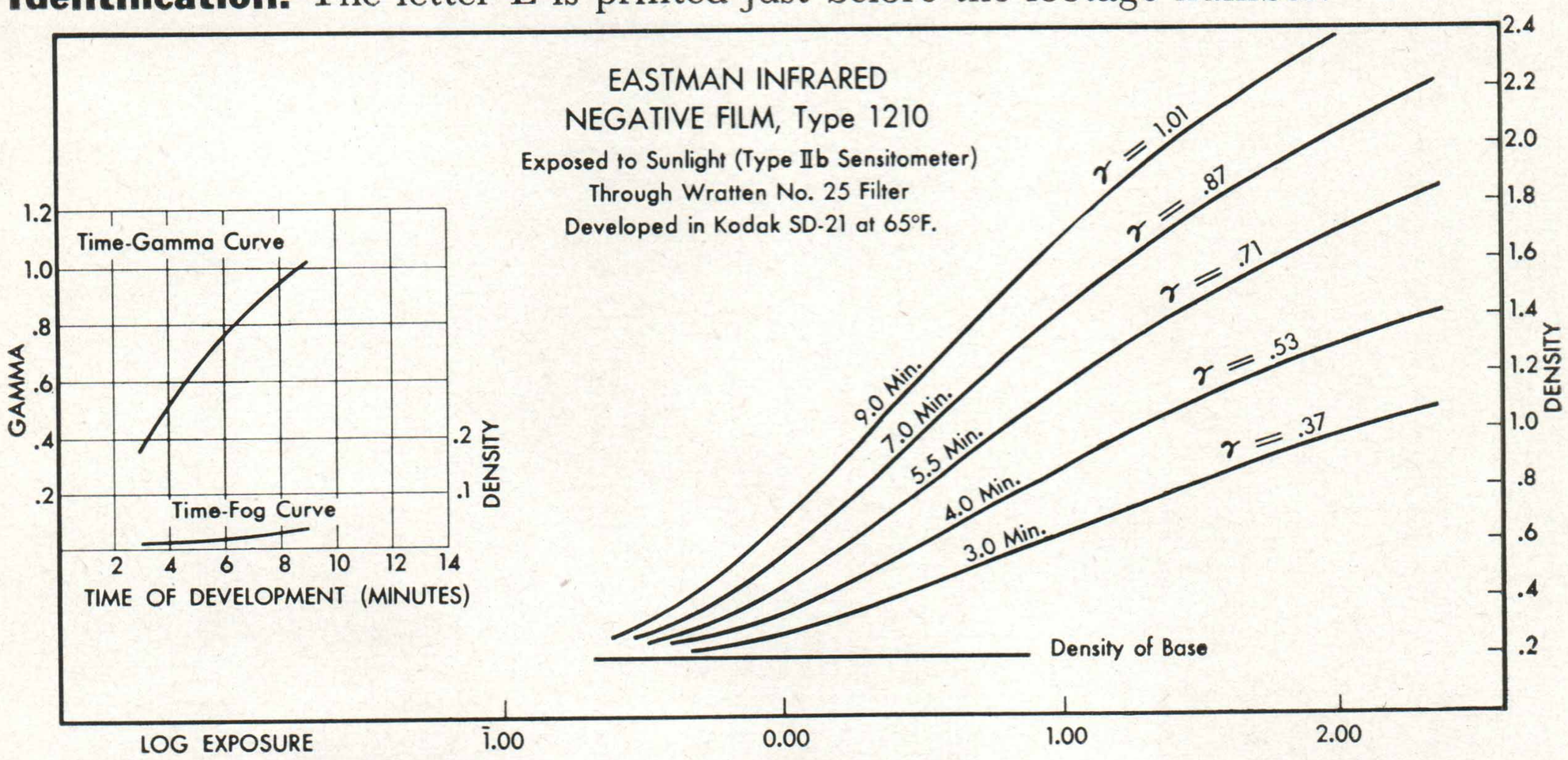
Recommended IIb Control Gamma: 0.60 to 0.70. For special effects, higher or lower contrast may be desirable.

Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 7 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of one minute at 3 feet.

Base: Gray nitrate. **Rolls Available:** 35-mm. x 100, 200, 400, or 1000 feet.

Perforations: Standard 35-mm. Negative. **Cores and Winding:** See previous page. Standard, specify on order.

Identification: The letter E is printed just before the footage number.



EASTMAN KODAK COMPANY • ROCHESTER, N. Y.

SEPTEMBER, 1943-CH PRINTED IN THE UNITED STATES OF AMERICA

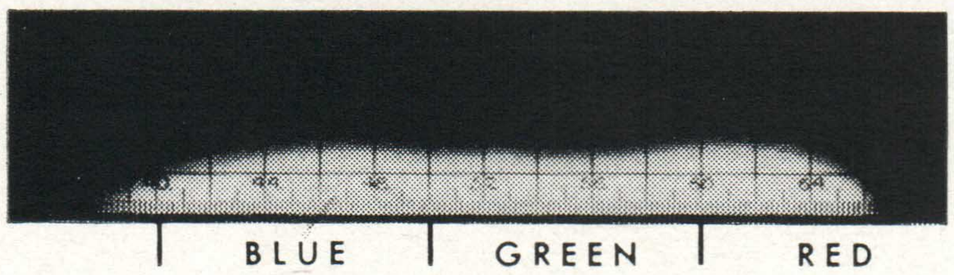
Specifications—EASTMAN BACKGROUND PANCHROMATIC NEGATIVE FILM, Type 1213

General Properties: A low speed negative material of extremely fine grain. Intended primarily for use in making original negatives from which prints are to be made for background projection, it is also suitable for general exterior photography and for special purposes, such as making title negatives or duplicate negatives, when additional sensitivity for copying or printing is necessary. This film, the slowest of the Eastman panchromatic picture negative materials, is the finest in grain.

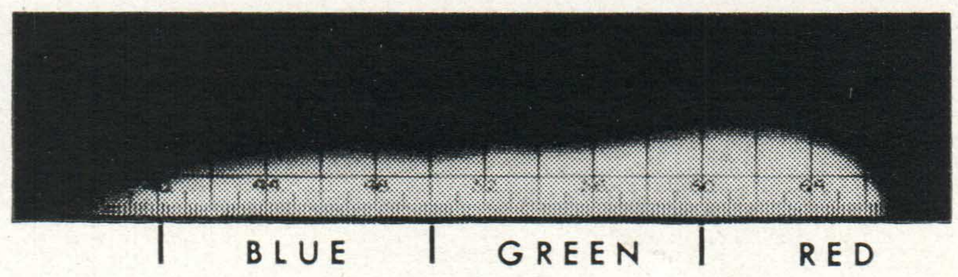
Speed and Recommended Exposure Meter Settings: For development in seasoned Kodak D-76 (SD-21) to a gamma of 0.75.

Kodak Film Speed	Meter Settings	Weston	G. E.
Sunlight 40 Tungsten 24	Sunlight Tungsten	10 6	16 10

Color Sensitivity: Panchromatic.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

Filter Factors: See Filter Exposure Table, page 15.

Recommended IIb Control Gamma: 0.60 to 0.80, depending on the purpose for which the film is used.

Resolving Power: 60 lines per mm. in Kodak SD-21.

Safelight: Total darkness preferred. After development is one-half complete, a Wratten Series 3 can be used with a 10-watt bulb at not less than 3 feet. The total exposure should not be greater than the equivalent of a few seconds at 3 feet.

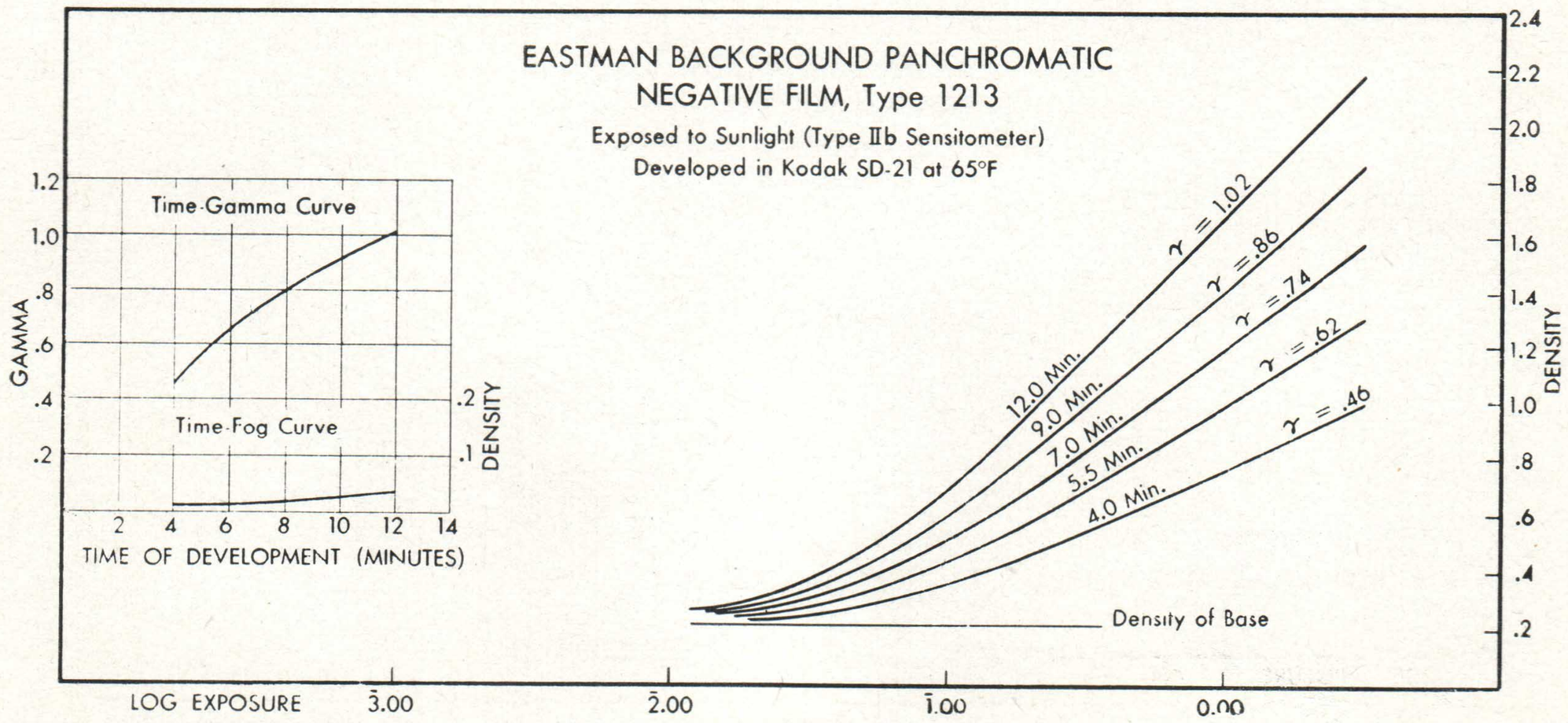
Base: Gray nitrate.

Perforations: Standard 35-mm. Negative.

Rolls Available: 35-mm. x 100, 200, 400, or 1000 feet.

Cores and Winding: See page 40.

Identification: The letter B is printed just before the footage number.



Specifications—EASTMAN FINE GRAIN SOUND RECORDING FILM, Type 1372 (35-mm.) and Type 5372 (35- and 16-mm. Safety)

General Properties: Especially adapted for use with variable area sound recording equipment. It is not suitable for variable density recording. This emulsion extends the frequency range beyond that which can be recorded on other sound recording films.

This material can be used as a negative by exposing to a high density (2.1 to 2.5) and printing onto emulsion 1302 or 5302.

It can also be used with excellent results as direct playback positive material because of its low image distortion when the density produced by exposure in the recorder is in the range of 1.0 to 1.2.

In either case, the excellent image characteristics and finer grain of this material contribute toward recordings of superior quality.

Speed: Due to the characteristics mentioned above, a filter is not required when exposing this film. The speed without a filter is two and a half times greater than that of 1357 with the filters commonly used. The speed of 1372 to unfiltered tungsten light is considerably less than that of 1357 to unfiltered tungsten, but, if it is felt desirable to use an ultraviolet filter, 1372 will be found approximately equal in speed to 1357 with the same filter.

Sound Recording Exposure Numbers:

Light Source	Filter	Kodak Developer	IIb Control Gamma	Sound Track Density*	Sound Rec. Exp. No.
Tungsten	None	D-16	3.10	2.10	3700
Tungsten	None	D-16	3.10	1.20	6500†

*Silver density.
†For direct playback conditions.

Color Sensitivity: Blue sensitive only.

Spectrogram to Tungsten Light.

Recommended IIb Control Gamma: Variable area only, 2.9 to 3.3.

Resolving Power: 150 lines per mm.

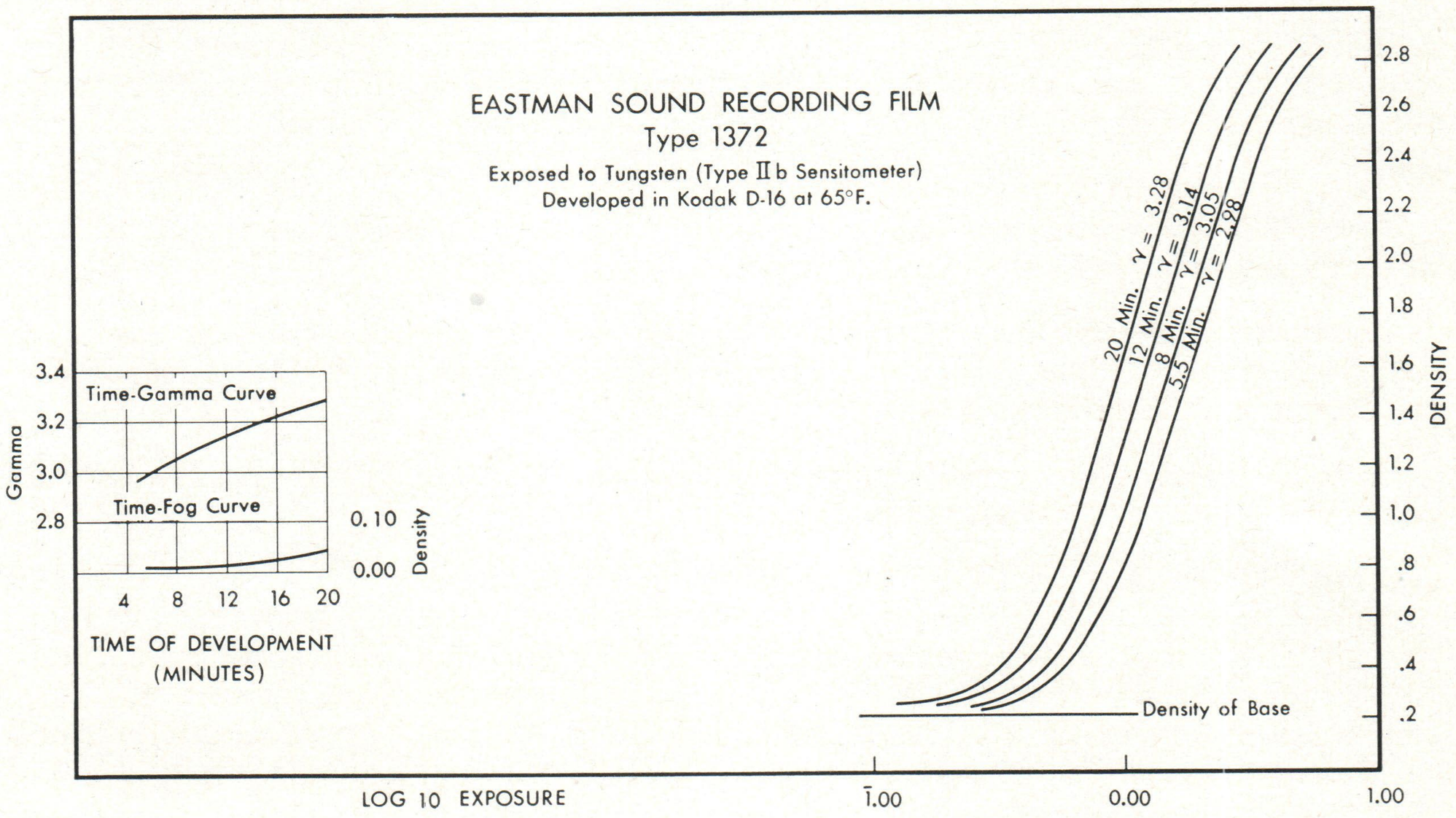
Safelight: Wratten Series 0 or 0A (orange or yellow-green).

Base: 35-mm. Gray Ciné Negative Nitrate. 16-mm. Safety Blue Ciné Negative.

Perforations: Standard 35-mm. Positive; Standard 16-mm. Sound (perf. one side).

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked); 16-mm. x 200 or 400 feet.

Cores and Windings: 35-mm. on Type R core, wound on; 16-mm. on Type T core, wound on. Winding A or B is used with 16-mm. Should be specified when ordering.



Sensitometric Curves: These data, applying to average product and average processing, are sufficiently accurate for all ordinary photographic work. For special problems, the material can be calibrated under the actual working conditions.

Motion Picture Film Department

EASTMAN KODAK COMPANY, ROCHESTER 4, N. Y.

66B

DECEMBER, 1944—PRINTED IN THE UNITED STATES OF AMERICA

Specifications—EASTMAN SOUND RECORDING FILM, Type 1373 (35-mm.) and Type 5373 (35- and 16-mm. Safety)

General Properties: This is a fine grain, variable density sound recording film of improved recording characteristics. It can be developed to a low gamma (e.g., 0.5) using a regular picture negative developer and without requiring an excessively short development time.

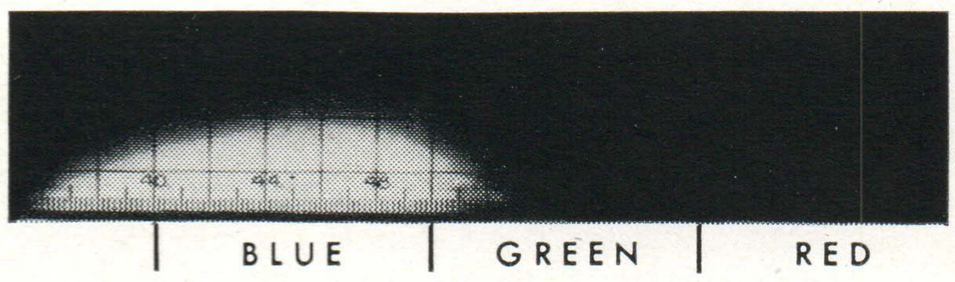
Speed: *1373* is similar in speed to *1370* but has more satisfactory sound recording characteristics. For critical work, speed should be determined by test.

Sound Recording Exposure Numbers: For development in Kodak SD-21 (a seasoned Kodak D-76).

Light Source	Filter	IIb Control Gamma	Sound Track Density	Sound Rec. Exp. No.
Tungsten	None	0.40	0.55	110
Tungsten	None	0.60	0.55	600
Mercury (85-watt)	None	0.40	0.55	280
Mercury (85-watt)	None	0.60	0.55	1500
Mercury (85-watt)	5840*	0.60	0.55	290

*Formerly Corning 584 Filter

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 0.40 to 0.60.

Resolving Power: Approximately 90 lines per mm. in Kodak SD-21.

Safelight: Wratten Series 0 or 0A (orange or yellow-green).

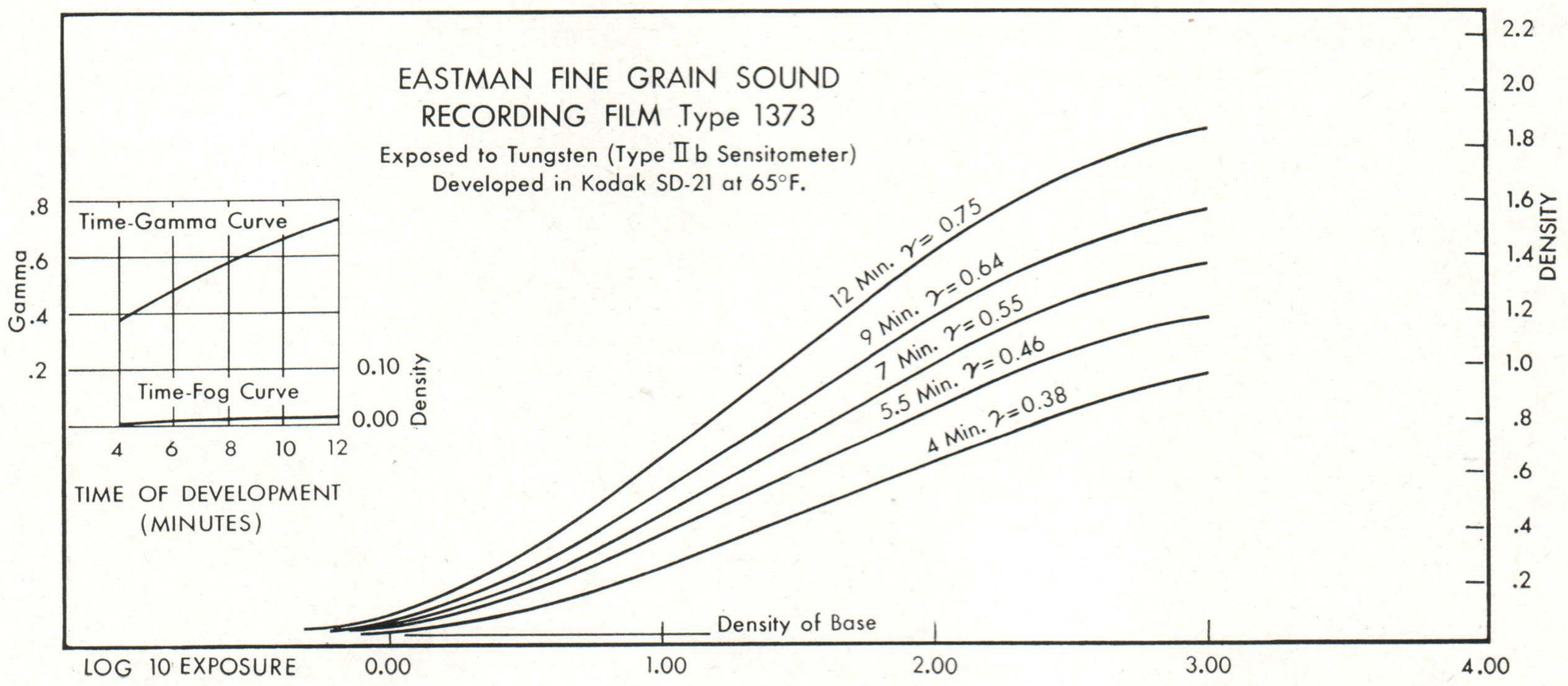
Base: Clear. 35-mm.: Nitrate (1373). 16-mm.: Acetate (5373). The 35-mm. width is available on acetate base on special order (5373).

Perforations: Standard 35-mm. Positive; Standard 16-mm. Sound (perf. one side).

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked); 16-mm. x 200 or 400 feet.

Cores and Windings: 35-mm. on Type R core, wound on; 16-mm. on Type T core, wound on. Available in either A or B winding; should be specified when ordering.

Identification: The letter S is printed just before the footage number on 35-mm.



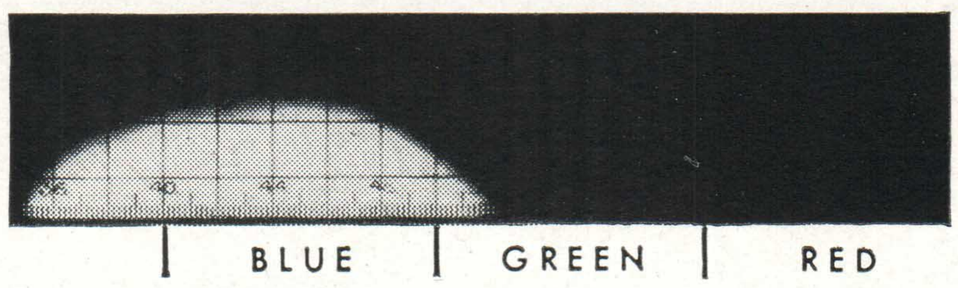
Specifications—EASTMAN RELEASE POSITIVE FILM, Type 1301 (35-mm.) and Type 5301 (35- and 16-mm. Safety) For Sound Recording

General Properties: This is the regular Release Positive emulsion provided with footage numbers. It is suited by development in a low contrast negative developer to variable density sound recording with the light-valve. Although *1301* is slower than Sound Recording, Type *1357*, and requires a higher lamp current for correct exposure, its inherent film noise is lower.

Sound Recording Exposure Numbers: For development in Kodak D-103.

Light Source	Filter	IIb Control Gamma	Sound Track Density	Sound Rec. Exp. No.
Tungsten	None	0.35	0.55	330
Tungsten	None	0.55	0.55	1400
Mercury (85-watt)	None	0.35	0.55	1100
Mercury (85-watt)	None	0.55	0.55	5000
Mercury (85-watt)	584	0.35	0.55	280
Mercury (85-watt)	584	0.55	0.55	1170

Color Sensitivity: Blue-sensitive only.



Spectrogram to Tungsten Light

Recommended IIb Control Gamma: 0.35 to 0.55.

Resolving Power: 55 lines per mm. in Kodak D-103.

Safelight: Wratten Series 0 or 0A (orange or yellow-green).

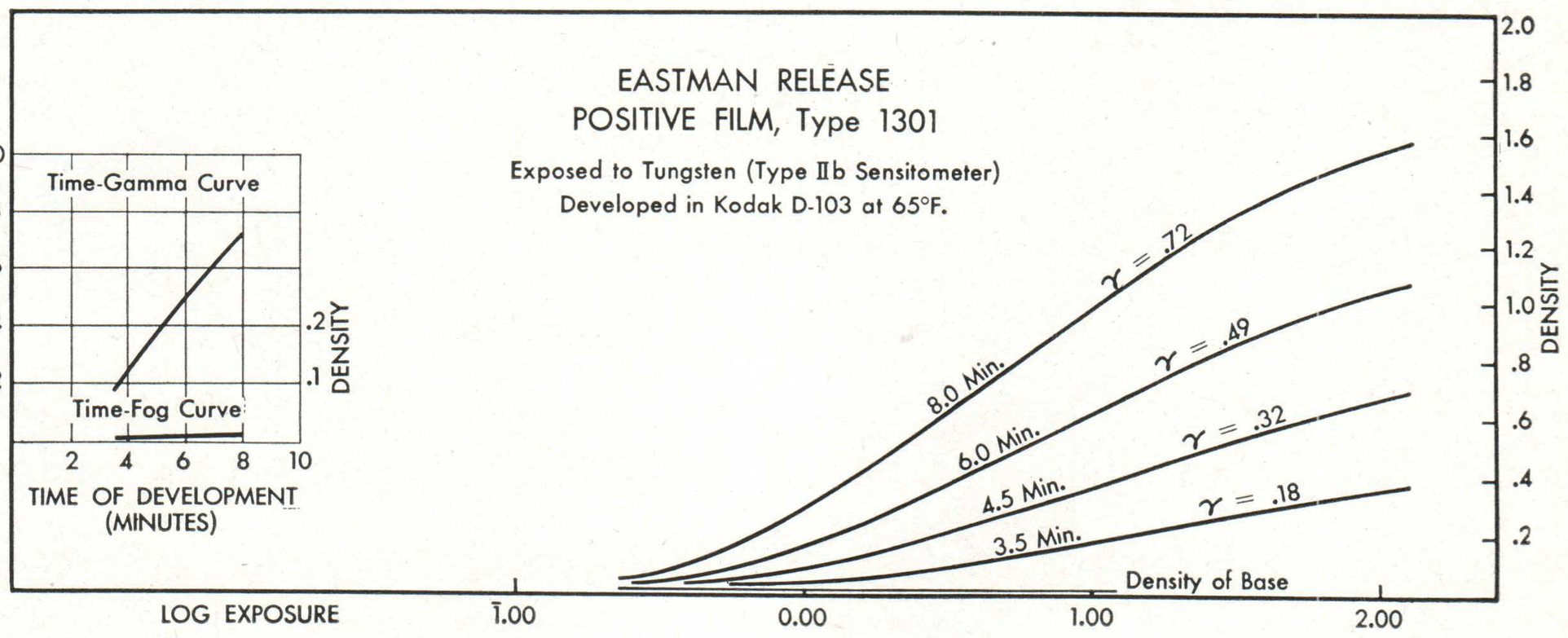
Base: Clear. *35-mm.*: Nitrate (*1301*). *16-mm.*: Acetate (*5301*). The 35-mm. width is available on acetate base on special order (*5301*).

Perforations: Standard 35-mm. Positive; Standard 16-mm. Sound (perforated one side).

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked); 16-mm. x 200, 400, 800, or 1200 feet.

Cores and Winding: 35-mm. on Type R core, wound on; 16-mm. on Type T core, wound on. Winding B is used with 16-mm.

Identification: This film does not bear an identifying letter.



12-44—PRINTED IN THE UNITED STATES OF AMERICA

Specifications—EASTMAN FINE GRAIN RELEASE POSITIVE FILM, Type 1302 (35-mm.) and 5302 (35- and 16-mm. Safety) For Sound Recording

General Properties: This is the regular Fine Grain Release Positive emulsion, provided with footage numbers. It is suited by development in a high contrast positive developer to variable area recording.

Sound Recording Exposure Numbers: For exposure without a filter.

Light Source	Developer	IIb Control Gamma	Sound Track Density	Sound Rec. Exp. No.
Tungsten	Kodak D-16	2.70	2.10	270

Color Sensitivity: Blue-sensitive only.

Spectrogram to Tungsten Light

Recommended IIb Control Gamma: For variable area recording, 2.6 to 2.8.

Resolving Power: 90 lines per mm. in Kodak D-16.

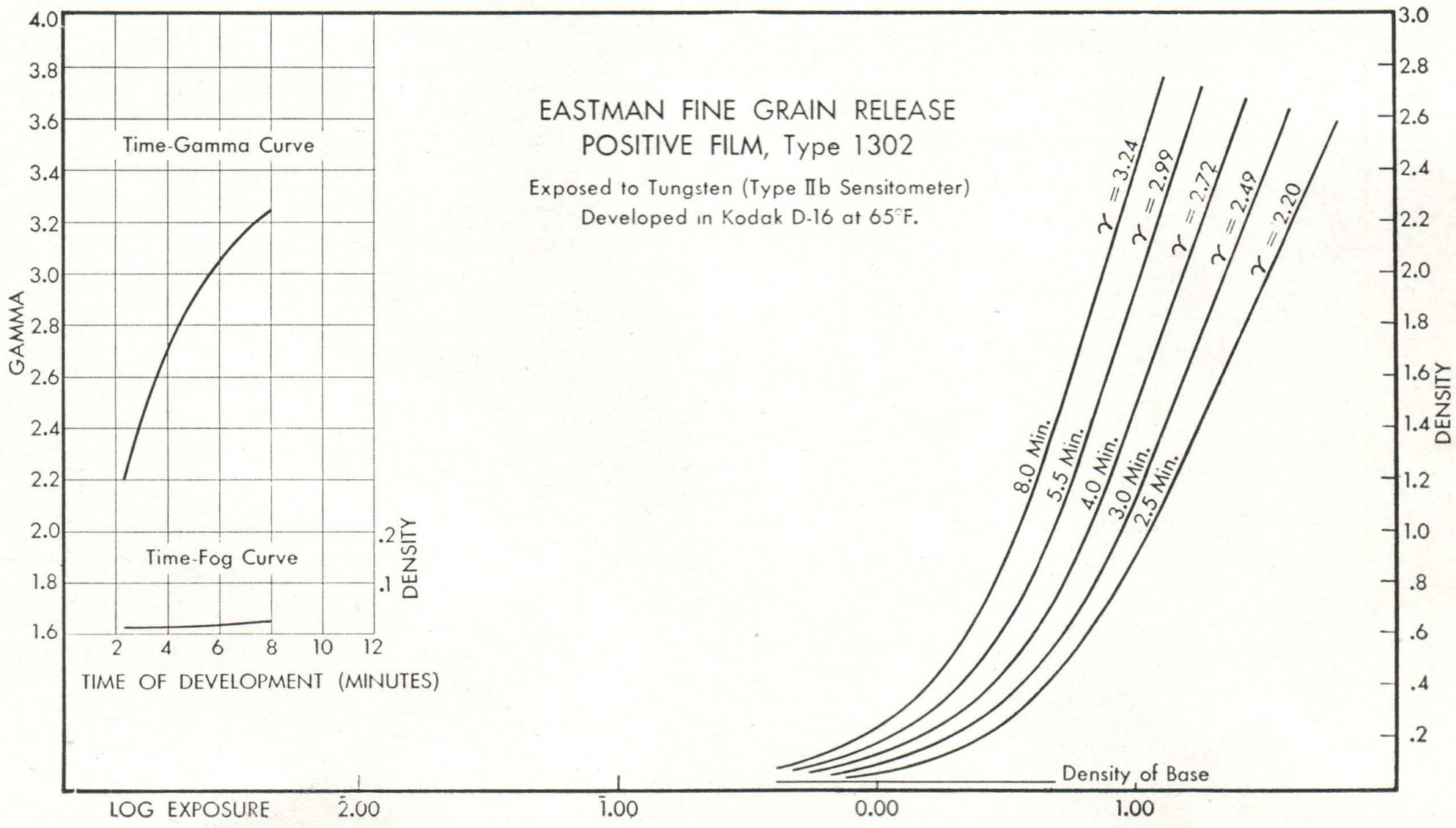
Safelight: Wratten Series 0 or 0A (orange or yellow-green).

Base: Clear. *35-mm.*: Nitrate (*1302*). *16-mm.*: Acetate (*5302*). The 35-mm. width is available on acetate base on special order (*5302*).

Perforations: Standard 35-mm. Positive; Standard 16-mm. Sound (perforated one side).

Rolls Available: 35-mm. x 400 or 1000 feet (footage numbered and frame-line marked); 16-mm. x 200, 800, or 1200 feet.

Cores and Winding: 35-mm. on Type R core, wound on; 16-mm. on Type T core, wound on. Winding B is used with 16-mm.



Specifications — EASTMAN LEADER STOCK — Nitrate (35-mm.) and Safety (35- and 16-mm.)

NITRATE LEADER

All nitrate leader is of the 35-mm. width and is supplied on Type U cores (domestic orders, wound on; export orders, inserted) in 1000-foot rolls. The rolls are packed in individual black paper envelopes, two to the can, but the cans are not packed in individual cartons, except on export orders. On special order, nitrate leader is available perforated otherwise than indicated in the following paragraphs.

Eastman No. 3 Title Stock. Transparent uncoated support approximately 0.00538 in. thick. Standard 35-mm. Positive perforations.

Eastman No. 3 Machine Leader. Transparent uncoated support approximately 0.00538 in. thick. May contain scratches or various other defects. Standard 35-mm. Positive perforations.

Eastman No. 6 Blue White Machine Leader. Blue support with white pigment coating on one side, approximately 0.00790 in. thick. Oversize Positive-type perforations.

SAFETY LEADER

Safety leader is supplied in 35-mm. (on Type U cores) and 16-mm. (on Type T cores) widths as indicated in the following paragraphs. Both 35-mm. and 16-mm. rolls are packed in individual black paper envelopes. The 35-mm. is packed in individual cans, but the 16-mm. is packed ten rolls to the can, with the exception of lengths over 400 feet, which are packed two rolls to the can.

Eastman No. 3 Safety Leader. Transparent uncoated support approximately 0.0055 in. thick. 35-mm. x 100 to 1000 feet. Standard 35-mm. Positive perforations or not perforated. Available on special order in the 16-mm. width.

Eastman No. 6 Safety Leader. Blue transparent uncoated support approximately 0.0075 in. thick. 16-mm. x 100 to 800 feet (Standard 16-mm. Silent perforations); 35-mm. x 100 to 800 feet (Standard 35-mm. Positive perforations)

Eastman No. 6 Safety Leader (Black-and-White Opaque). For 16-mm. processing machines. Approximately 0.0075 in. thick. 16-mm. x 400 or 1000 feet. Available perforated or not perforated.

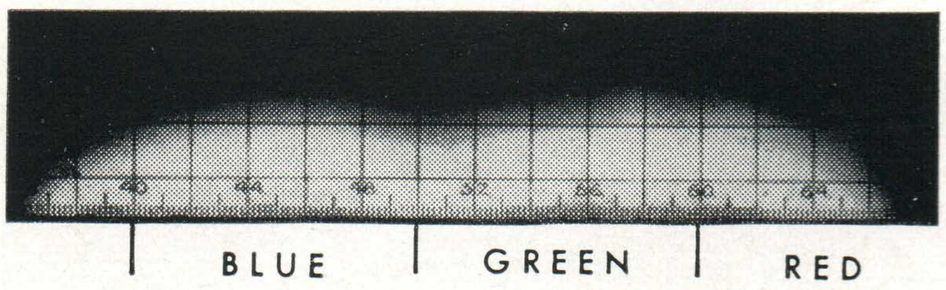
Specifications—CINÉ-KODAK SUPER-X PANCHROMATIC FILM (16-mm.) CINÉ-KODAK EIGHT SUPER-X PANCHROMATIC FILM (8-mm.)

General Properties: Reversal type, reasonably high-speed, Type C Panchromatic films of fine grain and good contrast. Fast enough for indoor work with ample artificial light, or exterior filming in unfavorable light. Processed with controlled printing exposure.

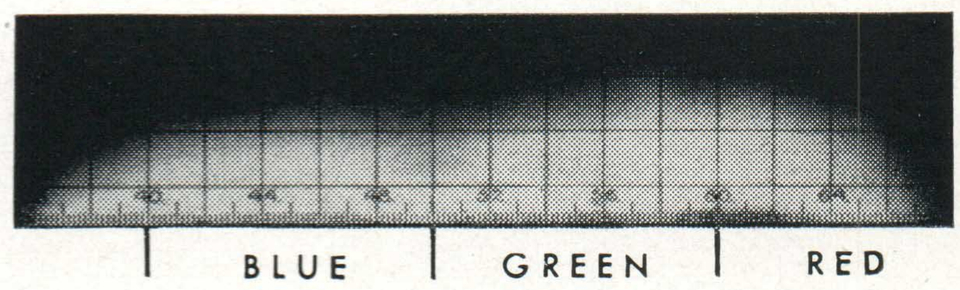
Recommended Meter Settings:

Light Source	Exposure Meter Settings	
	Weston	General Electric
Daylight	32	50
Tungsten	24	40

Color Sensitivity: Panchromatic, Type C.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

Filter Factors: (Correction filters: Sunlight X1; Tungsten X2).

Filters	CK-3	G	X1	X2	A	B	C5	ND-2	Kodak Pola-Screen Type 1A
Sunlight	2	2.5	5		4	7	5	4	2
Tungsten	1.5	2	4	5	2	6	10	4	2

Daylight Exposure Table: Shutter speed approximately 1/35 second—16 frames per second.

Prevailing Light Condition	Subject Types—Front Lighting				Side or Back Lighting No Reflector
	Brilliant	Bright	Average	Open Shade	
	Beach Scenes Snow Scenes	Open Lighting No Deep Shadows	Some Shadows	Porches, Under Trees	
Bright Sun	*f*/11 + ND-2	*f*/16	*f*/11	*f*/5.6	½ to 1 stop more
Hazy Sun	*f*/16	*f*/11	*f*/8	*f*/4	½ to 1 stop more
Cloudy-Bright	*f*/11	*f*/8	*f*/5.6	*f*/2.8	
Cloudy-Dull	*f*/8	*f*/5.6	*f*/4	*f*/2	

For sound films 24 frames per second, use ½ stop larger.
For slow motion 64 frames per second, use 2 stops larger.

Photoflood Exposure Table: Shutter speed approximately 1/35 second—16 frames per second. For 24 frames per second, use ½ stop larger.

Number of Photoflood Lamps Polished Reflectors		Distance of Lamps to Subject in Feet						
		3	4	5½	8	11	16	22
No. 1	No. 2	Lens Aperture Required						
3	2	*f*/11	*f*/8	*f*/5.6	*f*/4	*f*/2.8	*f*/1.9	*f*/1.6
6	4	*f*/16	*f*/11	*f*/8	*f*/5.6	*f*/4	*f*/2.8	*f*/1.9

Illumination (Incident Light) Table: Shutter speed approximately 1/35 second —16 frames per second. For 24 frames per second, use ½ stop larger.

Lens Apertures	*f*/1.9	*f*/2.8	*f*/4	*f*/5.6	*f*/8	*f*/11	*f*/16
Number of foot-candles required.....	85	170	340	680	1360	2720	5440
Two No. 1 Photofloods in Kodaflectors at.....	9′	6′	4¼′	3′	2¼′		

Resolving Power: 75 lines per mm.

Perforations: 16-mm. available perforated on one or both edges for silent or sound cameras. 8-mm. available only in 16-mm. widths perforated for 8-mm. cameras.

Processing: The purchase price of Ciné-Kodak Film includes the cost of processing it to a projection positive. The film is returned by third-class mail within the country of purchase.

Rolls Available: 16-mm. x 50, 100, or 200-foot rolls, 50-foot magazines, and in packettes for Simplex Pockette and Filmo 121. 8-mm. x 25-foot rolls, 25-foot magazines.

Sales Service Division

EASTMAN KODAK COMPANY · ROCHESTER 4, N. Y.

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Specifications—CINÉ-KODAK SUPER-XX PANCHROMATIC FILM (16-mm.)

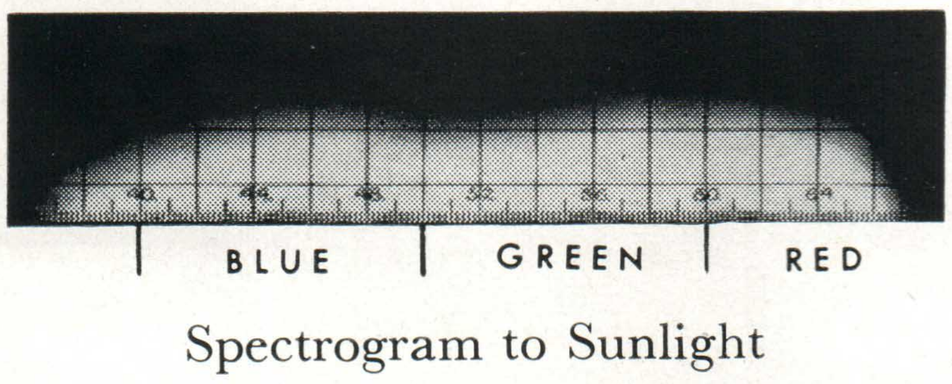
General Properties: A reversal type, high-speed, Type C Panchromatic Film which has more than twice the speed of Ciné-Kodak Super-X Panchromatic in both sunlight and tungsten light. It is especially useful for interiors with artificial light, also for sports pictures made at regular speed or slow motion in bad light or late in the day. It greatly extends the motion-picture possibilities in unfavorable lighting conditions, and is excellent for use for slow-motion pictures at camera speeds of 32 and 64 frames per second.

The speed of Super-XX is so great that, when pictures are made on it in bright sunlight, it is necessary to use the ND-2 (Neutral Density .6) Filter and a diaphragm opening of *f*/11.

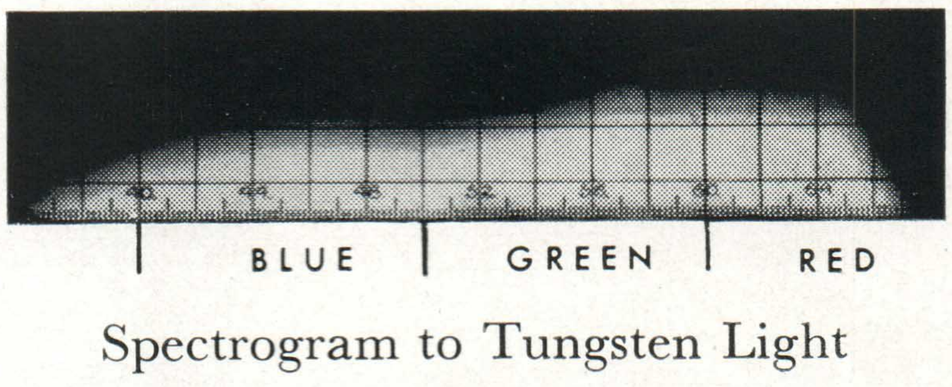
Recommended Meter Settings: Shutter speed approximately 1/35 second—16 frames per second.

Light Source	Exposure Meter Settings	
	Weston	General Electric
Daylight	80	125
Tungsten	64	100

Color Sensitivity: Panchromatic, Type C.



Spectrogram to Sunlight



Spectrogram to Tungsten Light

Filter Factors: (Correction filters: Sunlight X1; Tungsten X2)

Filters	CK-3	G	X1	X2	A	B	C5	ND-2	Kodak Pola-Screen Type 1A
Sunlight	2	2.5	5		4	7	5	4	2
Tungsten	1.5	2	4	5	2	6	10	4	2

Daylight Exposure Table: Shutter speed approximately 1/35 second—16 frames per second.

Prevailing Light Condition	Subject Types—Front Lighting				Side or Back Lighting No Reflector
	Brilliant	Bright	Average	Open Shade	
	Beach Scenes Snow Scenes	Open Lighting No Deep Shadows	Some Shadows	Porches, Under Trees	
Bright Sun	*f*/16 + ND-2	*f*/11 + ND-2	*f*/16	*f*/8	½ to 1 stop more
Hazy Sun	*f*/11 + ND-2	*f*/16	*f*/11	*f*/5.6	½ to 1 stop more
Cloudy-Bright	*f*/16	*f*/11	*f*/8	*f*/4	
Cloudy-Dull	*f*/11	*f*/8	*f*/5.6	*f*/2.8	

For sound films 24 frames per second, use ½ stop larger.

For slow motion 64 frames per second, use 2 stops larger.

Photoflood Exposure Table: Shutter speed approximately 1/35 second—16 frames per second. For 24 frames per second, use ½ stop larger.

Lens Apertures	*f*/1.9	*f*/2.8	*f*/4	*f*/5.6	*f*/8	*f*/11	*f*/16
Number of foot-candles required.....	30	60	120	240	480	960	1920
Two No. 1 Photofloods in Kodaflectors at.....	15′	11′	7½′	5′	3½′	2½′	1¾′

Resolving Power: 60 lines per mm.

Perforations: Available in either double or single perforations for silent or sound cameras.

Processing: The purchase price of Ciné-Kodak Film includes the cost of processing it to a projection positive. The film is returned by third-class mail within the country of purchase.

Rolls Available: 16-mm. x 50, 100, 200-foot rolls, 50-foot magazines, and in packettes for Simplex Pockette and Filmo 121.

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